Factory Management and Maintenance

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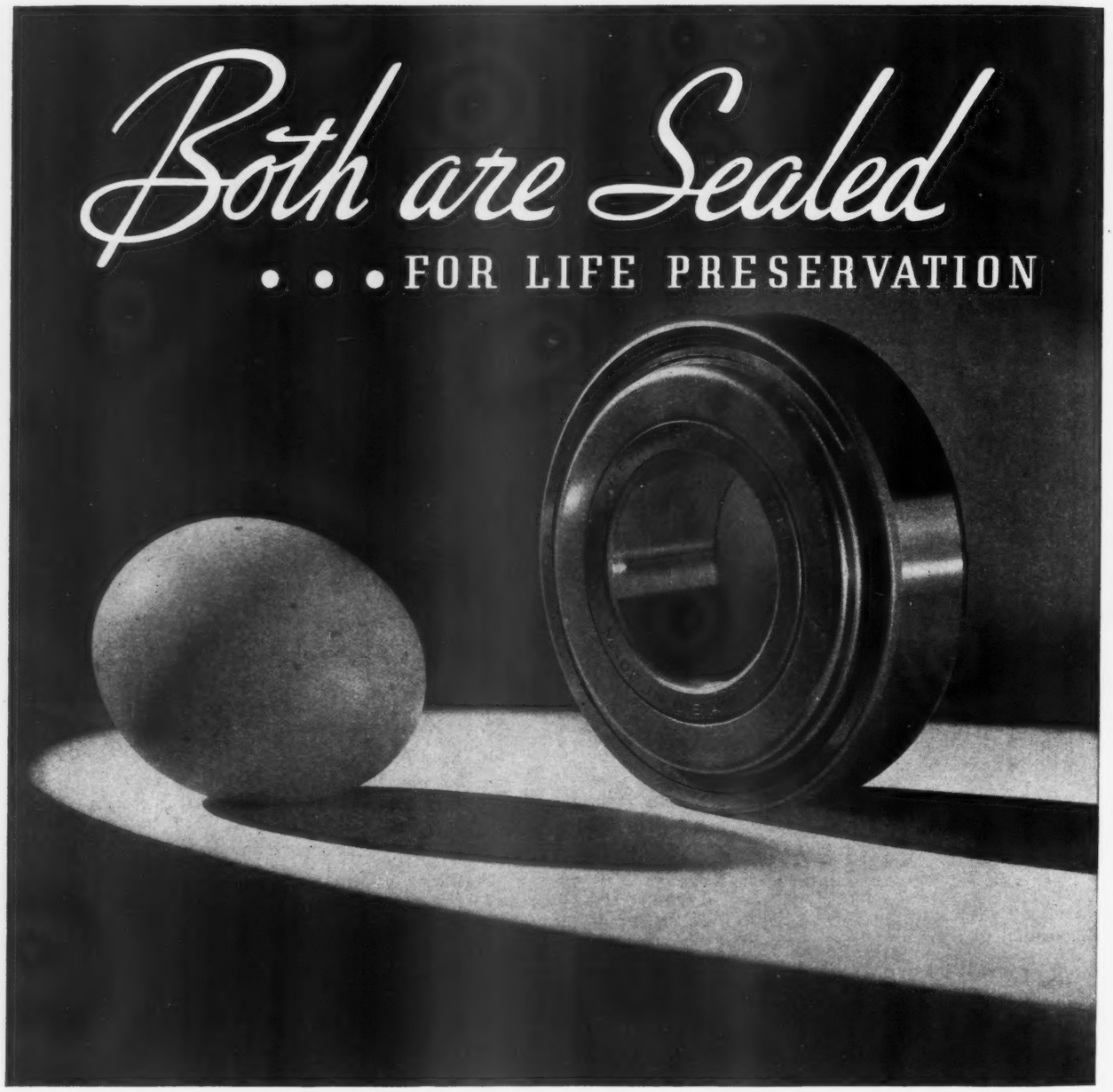

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2568

Factory
Management and Maintenance
L. C. MORROW • EDITOR

And What About Labor's Responsibilities?

LABOR, as represented by CIO in the field, is showing no real sense of responsibility. The steel strike has demonstrated this fact forcefully.

Acceptance of responsibility would call for a consistent attitude of fair play. There is no such attitude. If it was in order for strikers to be housed in the automotive plants, why is it not in order for non-strikers to be housed in steel plants?

If the stay-in strikers were entitled to be fed, why aren't the stay-in non-strikers entitled to be fed?

If it is proper for strikers to be kept away from the influence of public opinion and the influence of men not on strike, why isn't it proper for non-strikers to be segregated?

If a man is entitled to exercise his privilege not to work, why isn't he entitled to exercise his privilege to stay on the job?

The leaders of the CIO movement are blameworthy on these several counts and others where they have shown a total disregard for fair play. But they should not be saddled with all the blame. Real responsibility for the approach to mob rule that we have been experiencing must be placed at other doors.

Beginning with the forgotten-man campaign, the "rights" of labor and the "unfair practices" of employers have been asserted so repeatedly that a revolt of some kind, almost certain to be expressed in violence, was the inevitable outcome.

And what have the protectors of the forgotten man done about it? They themselves have forgotten the public interest. They have sat by with no word of condemnation for unlawful procedure by strikers. They have shown surprising disregard for the right of non-strikers to work. They have endorsed closing of plants that has forced idleness on thousands.

Rule by force is not a nice thing to contemplate. It has not been a nice thing to endure in Lansing and Youngstown. It is high time that the administration do or say something to imbue the offending labor groups with a sense of responsibility.

Labor, the CIO, and Steel

Independent reports by two experienced observers. Even if the steel strike is settled by the time this issue is off the press, they remain timely documents which reveal much of the background that made disagreement inevitable

What's Back of the Fight?

FRANK RISING
Industrial Relations Editor, Factory

THERE HAS BEEN from the beginning more than one way to look at the steel labor trouble—in fact, there have been so many viewpoints that it's difficult even now to resolve majority sentiment with management, labor, or the general public.

In the first place, Youngstown is not Cleveland, which in turn differs from Chicago and from Buffalo. Then, when you back away from the local scenes and attempt to get a long-range view of it, the consensus changes again. For the benefit of *Factory* readers who, like the late Will Rogers, must get most of their news from daily newspaper reports, an attempt has been made to get all these viewpoints first-hand.

The summary necessarily contains a great many "if's, and's, and but's" at this stage, but some essentials stand out pretty clearly and can be set down on the record.

It's About Like This

Briefly, the feeling about unionization shapes up like this:

1. Steel, like nearly every other business, has a lot of employees who want to join a union and a lot who don't. Even the plants that have contracts arranged by the Steel Workers Organizing Committee aren't 100 per cent pro-union.

2. Management in steel is of two minds about unionization, and has been for some time. As nearly as can be estimated, the division is about 50–50. The same division of sentiment runs through all other businesses, so that the independent steel companies which stood firm against the SWOC demand for a contract had many parties pulling for them, many pulling against them.

3. The general public—that part of it which is neither management nor wage earner—is in great part rather reserved in opinion and hesitates to render a hard-and-fast verdict. Locally, the citizen in a strike-ridden community gets sick of the tie-up quickly; more distantly, the citizen who reads about it in the papers is likely to take a certain pleasure in seeing big headlines. He rather enjoys reading about a fight, if the antagonists are evenly matched. He doesn't begin to be personally concerned, usually, until the ricocheting slugs begin to whistle about his own ears. In all fairness, however, it must be said that the average citizen doesn't want anybody killed in labor disputes.

Labor Is of Two Minds

From the foregoing, the impartial observer must find majority sentiment. As to management, the majority would rather not see unionization sweep the country; labor is of two minds, but is more for unions than against them; the public is divided, but is beginning to think of collective action as inevitable.

Add to these the weight of government, with some public officials in

International News

Strike or no strike, pay day was pay day at Inland Steel Company's plant in East Chicago

Right. Republic tells employees and public why it would not sign

THE REAL ISSUES

Republic Steel Corporation has been asked to sign the C. I. O. contract.

Why has that not been done?

Is it because Republic is unwilling to practice collective bargaining?

Is it because Republic pays low wages?

The answer to both these questions is No. Republic practices collective bargaining. It pays high wages.

Why, then, has Republic opposed the contract?

Because we are convinced this contract would be merely the first step toward a later demand for the closed shop and the check off.

These are the real issues in the present controversy.

It is time they were brought out into the open. Let the employees and the public face them squarely.

The closed shop and the check off do not involve wages or hours, or conditions of work.

REPUBLIC STEEL CORPORATION

favor of the open shop but a majority wanting to retain the goodwill of massed voting power and inclined to go along with the union movement. Then you will have the proper answer: The over-all majority is in favor of collective action.

Let's get down to cases and study the claims in the steel strike, which in the mind of the average man early resolved itself into a struggle between Republic Steel and CIO.

Claim 1—that Republic was set upon by a gang of "outside agitators" who forced honest workingmen to forego their pay against their will. *Counterclaim*—that Republic forced part of its labor to remain at work, under threat of dismissal, and refused to meet demands of a great majority for a signed contract.

Even SWOC Didn't Know

The fact is, many workers in Republic steel plants had been CIO-minded for months. Part of them have paid for dues buttons, part of them have only accepted pledge cards offered by the union. Even SWOC did not know the exact number of these men, but it is estimated a majority was with it when the strike had run a week. On the other hand, the company was right in thinking that a lot of workmen "went along" under pressure from the union.

Some of them expected a quick settlement of the strike—perhaps something like the 30-hour Jones & Laughlin tie-up, with early capitulation on the part of the other independents and little loss of pay, if any. This kind of union joiner was dismayed and disheartened by the evident strength of the independent sentiment. He is at best a very unstable foundation to build on.

Claim 2—that the National Labor Relations Board, by some means, was able to stop the strike but proved its own inadequacy and worthlessness by adopting a stand-offish attitude. This claim came, not from strikers nor from management, but from citizens and editorial writers.

The fact is, NLRB never had a chance in the early days of the steel quarrel to do anything, could do nothing until SWOC filed charges against Inland Steel. It has no authority to intervene in labor disputes; it has to be asked to investigate cases of discrimination by employers or to certify majority bargaining status of employee groups. Off the record, its regional offices can and do help straighten out tangles in many ways, but only after friendly invitation to enter the situation and investigate.

Nobody Asked For an Election

When the strike began, charges of discrimination which had been placed before the Cleveland regional office were washed up, some of them withdrawn, and others nullified by reinstatement of employees who had alleged discrimination. Nobody asked for an election to certify workers' majorities; the battle hung on something which was not then, and is not now, a matter of law—the necessity of signing contracts after agreements are reached on hours, wages, and working conditions.

In this connection, one great need of citizens today is re-examination of their governmental authorities. The Department of Labor, which appointed the steel mediation board, is the body that can intervene in labor disputes and send conciliators to deal with both parties; NLRB, on the other hand, is the agency which can investigate specific charges and complaints or can act to find out what group in a certain plant is entitled to recognition as the majority. That is about all it can do, under the Wagner Act. Too many people think NLRB is part of the Department of Labor and shares

the wide functions of the latter; it is not, and does not.

Claim 3—that the union was after the closed shop and the check-off, and that workers in general didn't want either of them. *Counterclaim*—that the independent steel companies were breaking the law by refusing to meet and deal with their employees, no matter what they wanted.

Both of these claims were unrealistic. The union had not asked for a closed shop nor for a check-off; most union members want the former but aren't excited about the latter. And the companies were breaking no laws; they had met with employees and faced no demands based on wages, hours, or working conditions.

This much may be said of the steel strike with certainty: *It was bound to come.* Sooner or later, the forces that insisted on the open shop were bound to meet the forces that insisted on the closed shop, in a showdown. Although the outcome of the Midwest steel strike will bring certain prestige to the winning side, it will not end the struggle between that part of America which believes in "individual" rights and that part which is talking for "collective" rights as opposed to single action.

The most important effect will not be locally, in its bearing on any one company, any single group of laboring men, or any political futures of public figures. It will be on public opinion throughout the United States which by and large is going to decide finally which of the disputants is in the right and deserves its support.

No CCC Pill for Republic

BURNHAM FINNEY
Western Editor, American Machinist

STRANGE things are happening in the present steel strike which extends over a far-flung front from Chicago to Buffalo and centers in the famed Mahoning Valley of Ohio. The strike was called by the Steel Workers Organizing Committee not because Republic Steel, Youngstown Sheet & Tube, and Inland Steel refused to bargain collectively, not because they have not been paying high wages, not because hours of employment have been too long, and not because working conditions were bad, but solely because the three companies stand adamant in their unwillingness to put their names on SWOC written contracts.

To the casual reader it may appear that the companies have chosen to quibble over a technicality. If they are willing to do all the things that a contract calls for, why not sign?

The real reason why the companies gag on the contract pill is that they are opposed to the "CCC." Those three letters may mean Civilian Conservation Corps to some people, but to the executives of the strike-bound companies they spell Contract, Closed Shop, and Check-Off. Hardly will the ink be dry on a contract before the union will come along, they feel, with a formal request for a closed shop. The check-off is but a step farther. John L. Lewis's strength in the coal industry has sprung from the financial security of the check-off which provides the United Mine Workers with its funds. What reason is there to believe that his goal in other industries isn't the same?

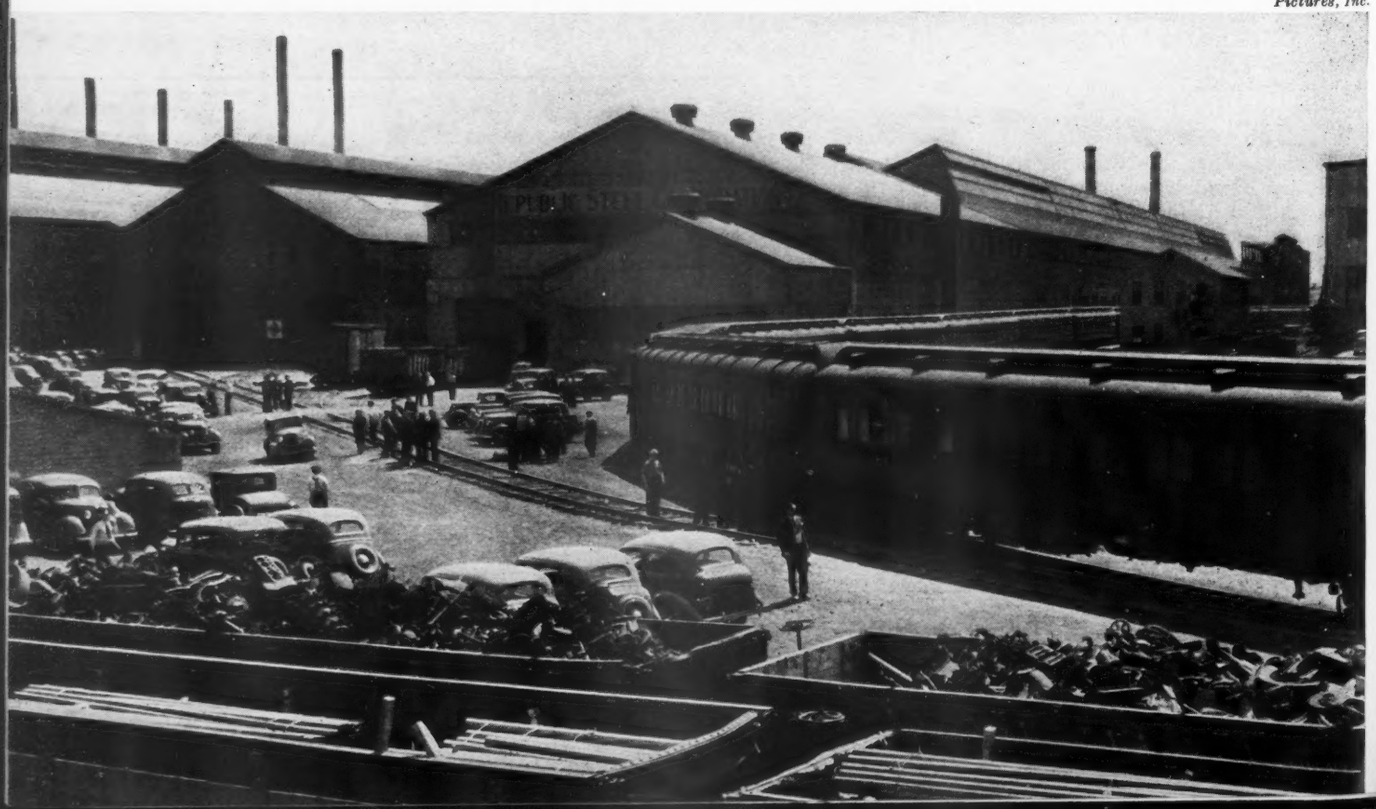
Let's see exactly where Republic and Sheet & Tube stand as disclosed by their official pronouncements.

Both companies emphasize that they always have fulfilled all labor obligations without signing an agreement. They point out that it is not customary in human or business relations to require parties to state in writing that they will obey the law, because that fact is assumed. Moreover a contract creates an artificial need for union officials to negotiate a new agreement every year, thereby subjecting the company to the risk of periodic shut-downs if the two parties don't agree.

Written labor contracts, they say, are not flexible. They usually apply for a twelve-months' period without changes. Under such a contract, steel employees would not have secured the two wage increases granted since last November 1.

Chicago's mayor said non-strikers must cease living in Republic's plant, held up his order when the company imported 21 Pullman cars

Pictures, Inc.



Right. Another page from Republic booklet explaining company's stand to employees, stockholders, public

WHY NOT SIGN WITH C. I. O.?

People ask, "Why don't you sign this contract with the C. I. O.? Isn't that the easiest thing to do?"

Of course it's the easiest thing to do. But that doesn't make it the right thing.

It is the course we might take if we cared nothing about our responsibility to our 59,000 employees and our 43,000 stockholders — who represent, with their families, about 400,000 people.

We can't let 400,000 people down, just because it's "the easiest thing to do".

We believe the interests of all these people are best served by standing firm against the closed shop and the check off.

This contract is a step toward the closed shop and the check off.

We do not want to take even the first step toward anything that we think might do harm to our employees and our stockholders.

REPUBLIC STEEL CORPORATION

A still more potent argument, believe the companies, is the fact obvious to any newspaper reader that signed contracts with labor unions have not brought industrial peace. Take General Motors as a shining example. It signed an agreement with the United Automobile Workers on February 11. Since then there have been 80-odd strikes in G.M. factories, showing that the union leaders who sign agreements on behalf of labor haven't the power to enforce them.

There is another slant on the situation, according to the companies. The National Labor Relations Act was not established in order to give bargaining for labor into the hands of one authority, the Committee for Industrial Organization.

If precedent means anything, a signed contract usually is used by the union to coerce and intimidate employees into joining.

No Clean Shirts

One extremely interesting chapter has been the attitude of the Post Office Department toward delivering mail to strike-bound mills. Attempts to ship in food to Republic workers at Warren, Ohio, by parcel post have been futile because the postmaster has refused to accept "irregular" packages. The postmaster there indicated clearly that strike leaders had been permitted to examine packages and decide whether or not they should be delivered.

In Cleveland local branch postmasters have rejected parcel post packages from wives containing clean shirts for their husbands on maintenance work in Republic's mills where no production operations have been attempted. The excuse has been the danger to which postmen would be subjected in passing through picket lines. At Youngstown, the postal ruling has been extremely drastic—no packages of any kind to be taken by the post office for delivery to maintenance men inside Sheet & Tube's idle mills.

Tactics familiar to those who have gone through labor crises in Akron and in Michigan have been used in the Mahoning Valley. Pickets are moved about from one plant to another and from one company to another. Many of them are strangers to the townsfolk. They have been armed with baseball bats and clubs. They have diverted traffic from public highways at will. In Youngstown they issue passes to cars and pedestrians to cross a public bridge spanning part of the Republic plant there.

When Republic Steel resorted to the daring and highly successful practice of flying food into its besieged Warren and Niles mills, strikers sniped at the planes. The union professed ignorance of the fact that its members were involved. Yet, as one observer points out, at 9 a.m. on a certain day the firing ceased and hasn't been resumed, which is pretty good proof that an order was issued from some central authority to stop that form of warfare.

The story of the election at Canton, Ohio, seat of Republic's mills, is enlightening. Workers were to vote at city hall on whether they wished to return to their jobs. When voting time arrived, the city building was picketed by union men, some of them having come from Akron, thus preventing the election. Later the Canton Chamber of Commerce launched a secret mail ballot on the back-to-work question. Some 6,500 ballots were printed on special watermarked paper with identification marks that could not be duplicated.

Extra Slow Service

Although sent first-class mail, it took twelve hours for these ballots to get out of the Canton post office. Meanwhile SWOC ran an ad in the local paper advising employees to boycott the vote. According to the story, 3,800 genuine ballots came back with an overwhelming vote for a return to work. At the same time about 2,500 phony ballots, all marked against resumption of oper-

ations, were received by the committee supervising the election.

The back-to-work movement has been given further impetus by the vote at the Newton Steel Division of Republic Steel at Monroe, Mich. It was conducted by the mayor with the use of the regular election machinery of the city. About 70 per cent of eligible employees voted. When asked, "Are you in favor of the strike?" 30 answered *yes* and 782 *no;* 856 voted their desire to return to work, with only 20 voting *no.*

A Million for Guns?

Both Republic and Sheet & Tube have insisted that company police refrain from use of firearms unless bodily attacked. That rule has been strictly observed. The riot at South Chicago was outside of Republic Steel's property and no company police were involved. There is said to be nothing to the charge that Republic has spent one million dollars for arms and ammunition for its various plants. When asked about expenditures of steel companies for firearms, one prominent executive who should know said, "I don't suppose the entire steel industry ever spent a million dollars for guns and ammunition in any 25 years of its life." Obviously steel companies maintain police forces to guard plants and materials worth tens of millions of dollars, but it is asserted that their activities in that respect go no farther than those of many citizens who have pistols in bureau drawers at home.

REPUBLIC STEEL WORKERS

Now Working

You are riding a losing horse. The C. I. O. has gone into this fight with a record of having never lost a strike. Republic Steel will not break that record.

This strike is being supported financially by all steel workers in the United States. 300,000 workers will donate one day's pay each month to see us win.

Other C. I. O. unions in this vicinity are supporting us physically. These include Timken, Hercules, Hoover and others. Akron rubber workers will close down their plants to come here if needed.

Republic coal mines are being closed down. Longshoremen are refusing to load and unload Republic freight.

Twelve of seventeen Republic plants are closed down completely. 44,000 out of 52,000 workers are striking.

Our pickets are well-fed and happy. Relief is being arranged for their families. Four departments of the United States government are fighting on our side.

REPUBLIC STEEL CORP. CANNOT WIN!

Your wives and families are worried about you and need you.

YOUR COMING OUT MAY BE THE DECIDING FACTOR IN GETTING US ALL BACK TO WORK!

You are still welcome out here with us. Extra precautions will be taken throughout the next 12 hours to guarantee your safety in leaving the plant. After that time your safety will be your own responsibility.

Above. In Canton, CIO distributed this handbill to men who wanted only to keep on working. Note implied threat in last line. Observe that "four departments of the United States government are fighting on our side"

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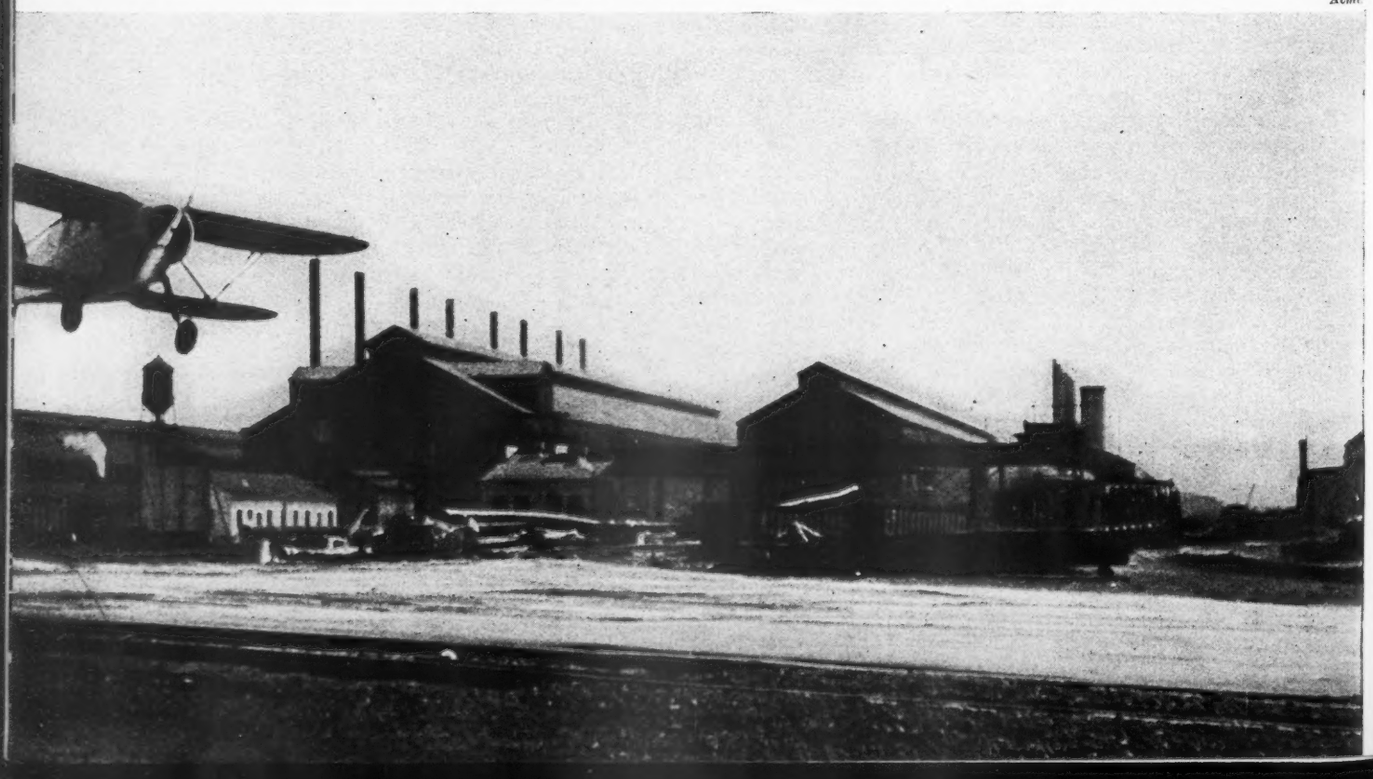


Below. While SWOC pickets besieged Republic's plant at Warren, Ohio—and before Governor Davey called out the guard to preserve the "status quo" requested by the President—food was rushed to loyal employees by plane

It's this way in Washington

Harris & Ewing

CARTER FIELD
Washington Correspondent

If the President were out of sympathy with CIO, he would quickly discover that his election debt had been long since paid. He is supporting CIO because he wants to, because he wants eventually a closed shop country

TWO THINGS about the make-up of Franklin D. Roosevelt baffle many of the business men who either call him names or profess helplessly that they cannot understand him. But if they will remember these two points, although it may not smooth their ruffled feathers any—quite the contrary perhaps—at least they will be able to piece out the puzzle in which they have regarded FDR himself and "whither are we drifting" as two of the imponderables.

One is his constantly manifested conviction that what "our fellows" do is all right, even when it is the same thing "we" may be bitterly condemning in the other fellow.

Examples of this are legion. Consider the recent bitter attack on the rich folks who have been taking advantage of loopholes in the law to cut down their income taxes. And then remember Roosevelt's own story to the reporters, when he was advocating certain changes in the tax law back in 1934.

So Long As It Was the Law—

With a humor that convulsed the 50-odd reporters listening, the President told how he had charged off depreciation on a barn, following the strict letter of the law, for income tax purposes.

He bought the farm in 1910, he said, and found the barn had been appraised by an insurance company at $4,000. Now this barn had been built while George Washington was president, he pointed out, but he nevertheless proceeded to deduct 2½ per cent of its value from his income every year before computing his tax. He did it every year until the barn burned down—in 1928.

Mind you, the President told this story for a good purpose. He wanted to show the absurdity of the law in permitting deductions from income for tax purposes. He wanted those loopholes plugged. But so long as it *was* the law he apparently saw no objection to taxpayers taking full advantage of it. In fact, some of his audience thought they detected, between the lines, a little pride in his adroitness.

On another occasion he was asked why he did not pay income taxes on his salary as President in view of the fact that he believes no salaries should be exempt. Mr. Roosevelt very frankly replied that the law did not require him to pay. He left the clear impression on that occasion that the law should be changed, but that those taking advantage of it should not be criticized.

Roosevelt *knows* that what he did was proper. He *knows* that when good friends of his did things they were proper. But when someone else does them, that is a little different—especially if holding that other person up to public scorn accomplishes something he regards as being for the common good.

Which leads us to the other factor—that the end justifies the means. Take the present labor situation as a perfect example. Mr. Roosevelt is encouraging labor elements that have no regard for law, order, or justice. He has thrown the strength of the government at Washington, and influenced many local authorities, notably the governors of two of the most troubled states, to throw all the strength of the local governments, behind the CIO unions.

Certain critics say that he is paying off an election obligation. That is not true. The President, were he out of sympathy with the CIO movement, would quickly discover that that obligation had long since been discharged. He is supporting CIO because he *wants* to support CIO, because he *wants* to win the present campaign, because he *wants* eventually a closed shop country.

There is to come a parting of the ways, because the President is *not* in sympathy with the thought of so much power being lodged in the hands of a few labor leaders, nor with the idea that they have all this power without any corresponding responsibility.

From a source very close to the President comes information as to the next step in this plan of labor, a step that will find him and John L. Lewis, and for that matter every other union leader, on the opposite side from the President.

Once the country is thoroughly closed shop, *then* and not till then—or possibly *almost* then—will come compulsory arbitration of all labor disputes, with the federal government sitting in as referee.

But capital must *first* be forced into a position where it is helpless before the labor union leaders—where it will be clamoring for compulsory arbitration, and willing to accept federal decisions.

Sheds Tears in Public

Meanwhile the labor drive is working toward the President's goal of a better or at least wider distribution of the fruits of industry, greater buying power for labor, etc.

For the present it is actually working against the interests of the underpaid, the border-line farmers, against the very one-third of the population over which he sheds so many tears in public. For practically all the men engaged in the recent labor troubles are above the lower third of the population.

The President has various plans for the benefit of this submerged third. If in the meantime they are hurt still more—by higher prices for what they buy, resulting from higher wages to other workers, payroll taxes, etc.—it is just too bad. We are looking to the future, *and the end justifies the means.*

Besides, the success of the present labor drive marks milestones toward the President's ideal of planned economy, with government supervising business, with no bad years and no booms, with no rich prizes and no poverty, and with Franklin D. Roosevelt big in future histories as the man whose vision and action started this Utopia.

Cash Out Is Cash In—on These Air-Conditioning Jobs

Ford finds conditioned air, even aside from departments where it is essential to product or process, pays in increased production, steadier output, better work, better health

ARTHUR VAN VLISSINGEN, JR.
Consulting Editor

THE APPROACH to air conditioning in office and factory may be sentimental and humane, or it may be hard-boiled and based on dollars-and-cents returns. In the plant where refrigeration is necessary to successful working of materials—for instance, a coating room in a chocolate candy plant—it is certainly based on economic facts. In the store or bank where it attracts customers on hot summer days, it can be economically justified.

In many offices, the management thinks it is a nice thing to have and installs it in the hope that it may be of value— but anyhow it makes things pleasanter for everybody, including the executive who okays the purchase order.

Tendency at Ford Motor Company is to condition air in more and more production departments, and to standardize on almost 100 per cent conditioning of office, engineering, and laboratory space

It is a safe generalization that air conditioning seldom is used in production departments unless there is an economic reason, a cash-and-carry result that can be demonstrated. The Ford Motor Company is notably free from any inclination to add frills, and expense, to its manufacturing operations.

More and More Conditioning

Yet even the casual visitor to the huge Rouge Plant is inevitably impressed that here exists probably more air conditioning and related forms of atmospheric treatment than he has ever seen before under a single ownership.

While it is never safe to generalize about Ford policies, it seems indisputable that the tendency is to condition the air in ever more and more production departments, and to standardize on almost 100 per cent conditioning of office, engineering, laboratory, and other departments staffed by people who must think on their jobs. Successive visits to Ford plants disclose increasing areas enclosed and conditioned.

Talks with Ford engineers in direct charge of this work make plain their desire to keep their thinking straight not only about whether a given area requires air conditioning, but also about just what constitutes air conditioning.

They make clear that what they mean by air conditioning is the complete job—filtering or otherwise cleaning the air, humidifying or dehumidifying it, cooling or warming it, circulating it. There are numerous places in and about Dearborn and the Rouge Plant where some less complete method of air treatment is employed because it fits the job at that point. But these are spoken of by terms that apply to such limited

treatment, and are not considered air conditioning.

A pioneer air-conditioning installation was at Ford's Engineering Laboratories Building. Part of this structure houses the offices of top Ford executives, but it was not for them that it was first employed. Rather it was to provide for the precision metal working, for the gages and blocks and millionth-of-an-inch measures, an atmosphere in which a measurement would always be the same, and where distortions due to temperature variations would be barred out. This purpose was accomplished. At the same time, it was clearly demonstrated that the engineers and executives housed here worked much more smoothly in times of climatic extremes than they previously had, and that absence due to illness — particularly respiratory illness — decreased substantially.

Better Work and More of It

The same results were obtained by the conditioning of the large Ford office building four miles to the east. In brief, the original cost and maintenance and operation of the air-conditioning equipment yielded a net profit in better work and more of it.

Consequently more and more of Ford office and laboratory and drafting room and engineering space has been air conditioned. Some of the conditioning problems have been hard to handle, such as those in the engineering department at the Rouge Plant. Here the building was designed for outside ventilation through monitor roof, skylights, and so on. The consequence is an abnormally large glass surface which in sunny weather, even in the winter, permits absorption of solar heat at a rate that may raise the room temperature. The plant for cooling this department was intentionally made oversize, and as weak spots have developed in the performance at working level more refrigeration has been

(Continued on page 144)

Close control of temperature and humidity insures close control of experimental work in the laboratories at the Rouge Plant

Cylinders are diamond-bored in this room, which is completely conditioned for precision metal working. Results obtained in this and similar production work have convinced Ford executives that air conditioning is profitable in a great many kinds of plant area where it has seldom or never been tried by other manufacturing concerns

Human Nature Is Dynamite

JOHN RICHELSEN
Personnel Director
Vanadium Corporation of America
Niagara Falls, N. Y.

HUMAN NATURE is ticklish stuff. Any personnel director who is worth his salt knows that human nature is dynamite whether the personnel is made up of grand opera divas or yard laborers.

The profit motive is often assumed to be the one and only consideration that controls the conduct of employees in industry. It seems to be taken for granted, particularly by capitalists who run a plant that is 500 miles away from their teletypes, that the pay check is the supreme solvent of all ills. No wonder there is frequent and serious bungling of labor relations.

Instead of a profit motive automatically controlling men, it is a fact that human nature often cuts diametrically across every consideration of profit and well-being.

The profit motive is not in control when a man "cuts off his nose to spite his face." The laboring man, under provocation, will jeopardize his job for the satisfaction of punching another, and everybody knows that individuals far higher up in the social scale than laborers are not immune to the impulse of accepting personal loss so that their human nature may have its exercise in seeing someone else get "what's coming to him."

It isn't questioned that men work for money, need it and demand it, fight for it and strike for it. But management doesn't know human nature if it thinks that all the ills of industrial relations can be met by an occasional 5-cent increase. Man lives by wages, but certainly not by wages alone.

Sometimes a company, seeking to drive out the restless spirit of dissatisfaction among its employees, sweeps and garnishes its payroll structure with upward strokes of the wage scale, only to find the devil of dissatisfaction returning again and bringing with him seven other devils worse than himself. Human nature elements have neutralized the effectiveness of the profit motive.

It were easier for a camel to pass through the eye of a needle than for a personnel director to enumerate all the disturbing factors arising in industrial operations. We confine ourselves to those that are remediable without radical social reconstructions.

His Field Is Broad Enough

The personnel director is not an auditor or comptroller. Heaven knows his field is broad enough without that. It is not for him to decide the justice of existing wage scales in relation to company earnings and company dividends. Of course he knows what is a living wage for the men. He has no chance to do his job at all unless the men are making a living. No management worthy of any respect will resent presentation of evidence by the personnel director that employees as a whole, or in part, are not able to sustain themselves in good working condition on their wages. But beyond that it is for the management to decide whether it is best to economize somewhere, refinance, cut dividends, attempt to run the plant with dissatisfied labor, or to close shop.

Emphatically it is the business of the personnel director to know, and to know how to deal with, labor dissatisfactions arising out of the facts of human nature. These are legion in their varied manifestations. Yet any personnel director who knows his job and who has had a few years of experience behind him can testify that 90 per cent of the troubles arising out of human nature factors (excluding monetary matters) may be classified into three general categories—favoritism, bossism, and the lack of discipline with disloyal employees.

There is no use of management's encumbering itself at all with a personnel director if it is not going to listen to, and act on, his findings and recommendations concerning favoritism, bossism, and disloyalties. The personnel director who is worthy of the management's confidence, knows human nature with its elements absurd and otherwise, and knows how to deal effectively with this human nature. He makes of his position something more than a sounding board for discordant noises.

(First in a series of very short articles based on the "Reflections of a Personnel Director." The second will appear in August.—ED.)

. . . easier for a camel to pass through the eye of a needle than for a personnel director to enumerate all the disturbing factors arising in industrial relations

Pay-Off on New Layout —150 Per Cent

Motion economy realizes annual savings of $2,700 from a job that cost $1,900. Back in March, 1933, *Factory* told how this concern, an early convert to motion study, applied the principles in one of its departments. Then it was collars for the well-dressed dog. Now it's taps for the shoe trade

WILLIAM T. CONNORS
Motion Economist, Graton & Knight Company
Worcester, Mass.

SHORTLY after we became actively interested in motion economy, and had made available to all our factory executives a practical course of study in this subject, we were confronted with this problem. We needed more room in the department where we manufactured leather taps for the shoe trade.

It was not feasible to spread out over a wider area, although it could have been done if absolutely necessary. Our first line of attack, therefore, was to see if the necessary space could be provided without taking space from some other department of the plant.

The foreman of this department was already sold on motion economy, knew the operation of his department thoroughly, and was anxious to improve conditions in it. Before we actually started to work, we explained and discussed the problem with the workmen. We placed particular emphasis on the benefit to them of steadier work and better wages, because cost reduction in the department placed the company in a better position to meet competition.

The first step was to make a complete process chart. This enabled us to make a detailed study of the flow of production.

Viewed then from the standpoint of motion economy, the process chart made it apparent at once that much unnecessary travel and handling could be eliminated. However, to determine exactly how much was unnecessary, we had to prepare templets of all the equipment. This enabled us to lay out the department in miniature, and to study each step in the manufacturing process. In doing this, each piece of equipment was placed so that, theoretically, each step in manufacture would follow the preceding step and give us a steady forward flow of production.

As we worked over this plan, arranging and rearranging templets, we saw that as much or more production could be assured by the introduction of simple mechanical conveyors, chutes, and proper work-receiving benches, which would speed up production and substantially reduce unnecessary travel and handling. We also saw that all this could be accomplished in very much less space than we were then using.

Only Five Racks Left

Due to the rehandling and backtracking necessary under the old plan, we had to use 80 stock racks. These were cumbersome, and took up a lot of space, and were often the cause of traffic jams which piled up additional unproductive labor and much unnecessary travel.

Even before we had worked out all the details of the new layout, we were able to discard 75 of these racks because, with one exception, the tentative plan eliminated all rehandling and rack storage. Besides the elimination of the stock racks, several production machines were discarded because, under the new layout, we could not only take care of present production, but also provide for increased production if and when it becomes necessary.

To understand clearly just what was done, let us make a direct comparison of the flow of production in the old method and the new.

Leather taps are produced from a section of the hide called a bend. The working stock of bends is carried in storage in the sole leather room. When being put into process, the bends were trucked in lots of 100 from the storage room to a floor scale, just outside the door of this department. Here they were weighed so that the percentage of waste from cutting might later be determined.

The load was then trucked to the cutting machine. After unloading the bends on his cutting tray, the cutter placed one bend at a time on the cutting block and died out the taps. When the die was loaded to its capacity of six or seven taps, depending on the thickness of the leather, he unloaded it and placed the taps in the portable rack directly behind him. This operation was repeated until the rack was loaded, when it was pushed to the grader.

The grader inspected the taps for thickness, because the price for taps is determined by thickness. The grader placed the loaded cutting rack on his left and graded from left to right, by putting taps through a special grading machine which indicated the exact thickness. As each tap was graded, he placed it in a stock handling rack. When the rack was loaded, it was pushed across to the sorter.

The sorter took two or three handfuls of taps from the rack and

PROCESS CHART
SOLE LEATHER DEPARTMENT

Travel	Old Process
	▽ Bends in stock rack for seasoning
160	(M) Get truck and go to storage
	(1) Load 100 bends on truck
205	(K) Take load to scale
	(2) Weigh
70	(K) Take load to cutting machine
	(3) Take bends from truck, Pile on mach. tray
	(4) Place one bend on cutting block
	(5) Cut taps
	(6) Place taps in rack
	▽ Repeat until rack is loaded
20	(K) Move load to grading machine
20	(M) Return to cutting machine
10	(M) Obtain empty rack and repeat as above
	(7) Take taps from rack
	[8] Grade taps
	(9) Take taps from grader
	(10) Place in empty rack
	▽ Repeat until rack is loaded
30	(K) Move loaded rack to sorters
30	(M) Return to grading machine
	(11) Take taps from rack
	(12) Pile on sorting bench
	◇ Sort taps
	(14) Place taps in rack on sorting bench
	▽ Repeat until rack is loaded
	(15) Take taps from rack on bench
	(16) Place in empty truck rack
	▽ Repeat until bench rack is empty
45	(K) Move rack to put-up bench
45	(M) Return to sorting
	(17) Take taps from rack
	▽ Place on make-up bench
	[18] Make up into dozens
	(19) Place at stamp
	(20) Stamp
	(21) Wire in dozens
25	(M) Go to box storage
25	(M) Return with boxes to packing bench
	(22) Place dozen taps in box
	(23) Pile for labeling
	(24) Label
	(25) Stamp size and grade
	(26) Pile boxes on truck
160	(E) Take load to shipping room
	▽ Storage
10	(K) Move truck to packing bench
	(27) Take packing list from load
25	(M) Walk to order file
	(28) Compare packing list with order
25	(M) Return to packing bench
	(29) Take boxes from truck, lay on bench
	(30) Place boxes in cartons
	(31) Seal cartons
	(32) Mark name and destination
25	(M) Go for wiring machine
25	(M) Return to packing bench
	(33) Wire cartons
	(34) Place on truck
15	(K) Take load to scales
	(35) Weigh
50	(K) Take load to shipping storage
	(36) Empty load on floor
60	(M) Return to packing bench
25	(M) Take sole leather truck to elevator
25	(M) Return to packing bench
	(E) Elevator to third floor
10	(M) Pull empty truck from elevator
	▽ Storage outside elevator
160	(M) Sole leather man walks to storage
	(37) Obtain truck
160	(M) Return to packing bench
1460	63 Operations and moves
	1460 Ft. travel

Travel	New Process
	▽ Bends in stock rack for seasoning
90	(K) Get truck and go to storage
	(1) Load 100 bends on truck
45	(K) Take load to scale
	(2) Weigh
20	(K) Take load to cutting machine
	(3) Take bends from truck, pile on mach. tray
	(4) Place one bend on cutting block
	(5) Cut taps
	(6) Place in chute by machine
	(7) Take taps from chute
	◇ Sort taps
	(9) Place taps in individual grade racks
	▽ Repeat until rack is loaded
	(10) Place loaded rack on conveyor
	(6) Sorter to grader
	(11) Take taps from rack on conveyor
	[12] Grade taps
	(13) Take taps from grader
	(14) Place in empty rack
	▽ Repeat until rack is loaded
5	(M) Push rack to put-up bench
	(15) Take taps from rack
	▽ Place on make-up bench
	[16] Make up into dozens
	(17) Place at stamp
	(18) Stamp taps
	(19) Wire in dozens
20	(M) Go to box storage
20	(M) Return with boxes to packing bench
	(20) Place dozen taps in box
	(21) Label
	(22) Stamp size and grade
	(23) Place in shipping cartons
	(24) Seal cartons
	(25) Mark name and destination
	(26) Wire cartons
	(27) Place cartons on truck
8	(K) Pull load to scales
	(28) Weigh
128	(E) Truck to shipping storage
	(29) Empty load on floor
	▽ Storage
128	(E) Return to sole leather
464	39 Operations and moves
	464 Ft. travel

	Old way	New way
Operations	63	39
Feet of travel	1460	464
Cost of change	$1900	
Annual saving	$2700	

placed them on his sorting bench. A stationary rack was built into the sorting bench, and as the sorter determined the quality of each tap he placed it in the correct compartment in the rack. When the bench rack was loaded, he transferred the sorted taps back to the portable rack, which he had previously emptied, and pushed it across the room to the put-up bench.

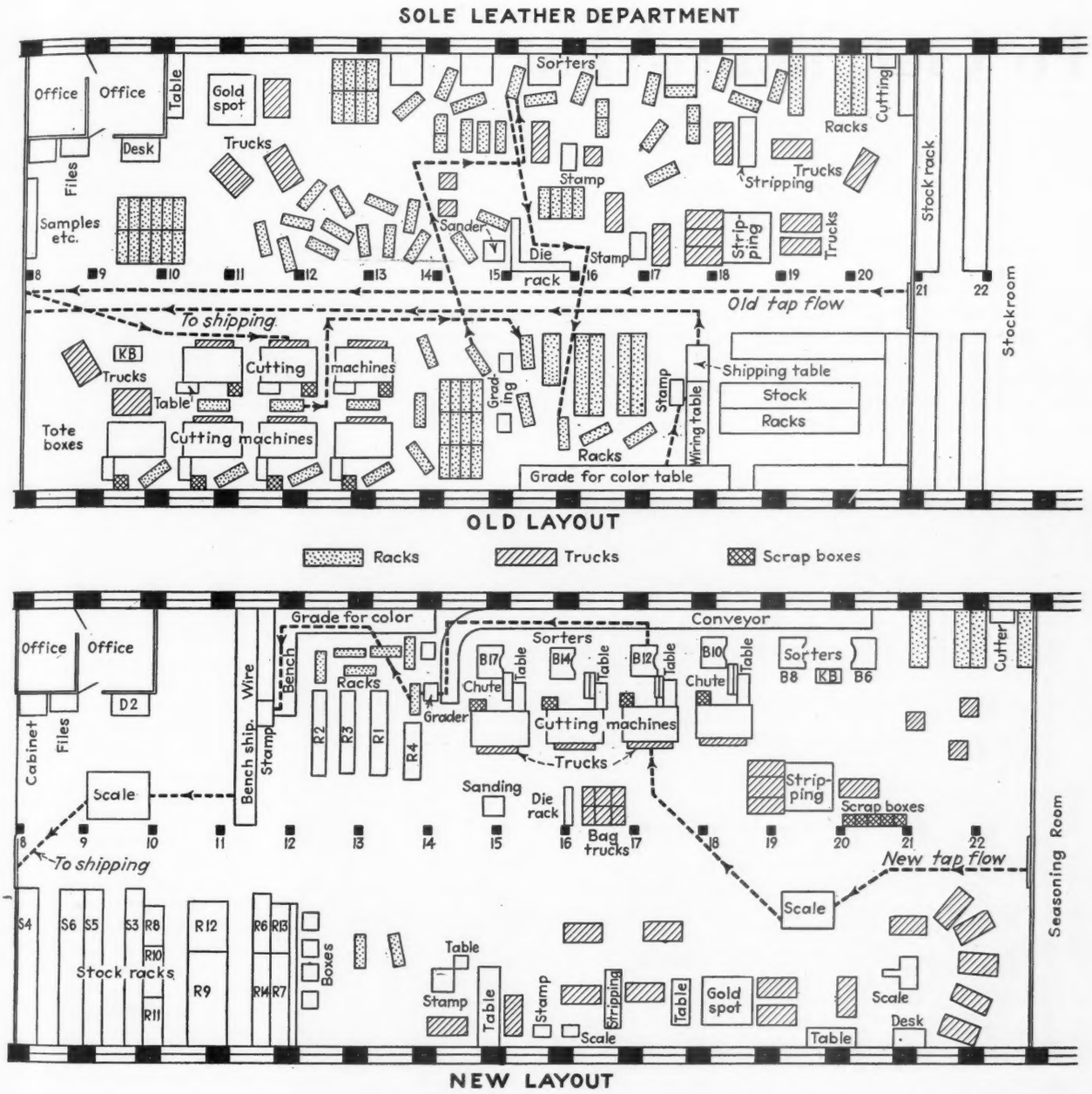
On the put-up bench, there is inspection for color to insure uniformity of color every dozen taps. The put-up man took the sorted taps from the rack and spread them on the bench to grade for color. As fast as he graded each dozen, he placed them at the stamping machine beside his bench, where they were stamped, wired, put into inside containers, placed on a truck, and delivered to the shipping department. The shipper took the taps from the truck, and placed them into outside cartons. The cartons were finally sealed, marked, wired, and put back on the truck, to be weighed before delivering to the shipping platform.

Tracing the New Flow

Now let us trace the tap flow in the new layout. The load of bends is taken from the storage room and weighed on a floor scale just outside this room. From the scale, the load is trucked to the cutting machine, where the bends are placed on the cutting tray. The cutter places one bend on the cutting block and dies out the taps. When his die is loaded, instead of emptying into a rack as he did in the old process, he places the taps in a chute which delivers them to the sorter.

The sorter sits directly behind the cutter at a specially designed bench for motion-economy sorting. On the bench are movable individual sorting racks. The sorter takes the taps from the chute at his side, and sorts into the individual racks. When one of these is loaded, it is placed on a gravity conveyor, at his side, where it is conveyed to the grader. To provide a continuous flow, we changed the sequence "from cutter to grader to sorter" to "from cutter to sorter to grader." This change assisted us tremendously from a motion-economy angle, without impairing the quality of the taps.

The rack is now at the grader, and the latter follows the same procedure as in the old layout—that is, grades from left to right into a color rack. The put-up man now takes the rack to the color bench and sorts into dozens for uniformity



of color as he did in the old layout. Each dozen is placed at the stamping machine where it is stamped, passed across the bench, wired, and put into inside containers.

Shipping Costs Down 60%

Another material change in the new plan is that instead of inside containers being placed on a truck and taken to the shipping room, they are put into cartons, sealed, marked, wired, placed on a truck, taken to the scale, and weighed—and the shipment is ready to be transported to the customer.

Time studies proved that by preparing for final shipment immediately after placing in inside containers, we have decreased the shipping cost at least 60 per cent.

Throughout the rest of the room, production has increased 25 per cent with the same man-hours. This was accomplished by converting into gainful productive time much of the time that was previously wasted in travel and handling.

This change also reduced the number of operations from 63 to 39; the travel from 1460 ft. to 464 ft. for each 100 bends. The cost of the change was $1,900, and the annual saving is $2,700.

This is merely one practical example of the savings we are making by correct application of motion-economy principles throughout our plant. Other projects that have shown substantial savings have been completed, and still others are now in process. Some of the projects have covered complete departments; others, individual operations in a department; and still others, individual operations that affect all departments. More and more emphasis is being placed on the application of motion-economy principles in every department, because we realize that we have only scratched the surface, and that many more important savings can be realized.

To Get Your Man

WALLY E. GEORGE
Industrial Engineer
American Steel Foundries, Chicago

INTO the office of the personnel director come, in turn, twenty young men. All have written acceptable letters of application, have submitted campus records that satisfy, and here they are, best foot forward, wanting a job. Only four, however, will be chosen, and the personnel director wants the best. Who should be picked?

There is the halfback from Northwestern with a fine record of achievement, the Phi Beta Kappa from Indiana, the burly boy from Nebraska with the hearty handshake, the quiet lad from Wesleyan who knows what he wants, and the math shark from M. I. T. who is within a thesis of his doctorate.

So runs the list of the twenty applicants. Again, who should be picked? Does the first man in or the last man out leave the better impression? Do first impressions of individuals prove more lasting than those gained later while talking across the desk? Can we rate the men or measure them without bias? Let's design a score card and try it.

To begin with, the tangible or factual items about a man may be tallied and an estimate made of his potential ability. You may score the facts as one total and the potentialities as another, but remember, the two will not add up, for they are as separate as history and hope.

A check list will simplify the scoring. Take the *facts* first. When the interview is over, the personnel director wants the answers to six questions:

1. How does he look?
2. How does he talk?
3. How does he act?
4. What is his background?
5. How good is his education?
6. What of his personal habits?

Eye-and-ear impressions supply answers to the first three questions. Answers to the next three will be developed as the applicant is engaged

INTERVIEW RATING CHART

DATE_____ NAME:_____

APPLICANT'S RATING ON FACTUAL ITEMS _____ ON INTANGIBLES_____

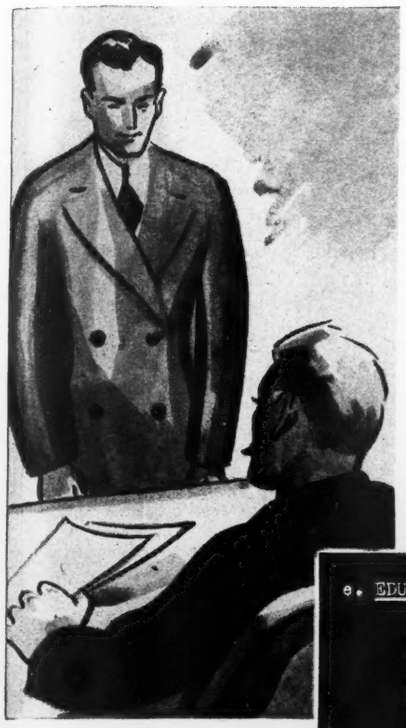
INTERVIEWED BY:_____

I. FACTUAL ITEMS

a. APPEARANCE:	
PHYSIQUE	- Tall, Medium, Short - - Fat, Regular, Thin
FACIAL LOOKS	- Excellent, Good, Fair, Poor
EYES	- Glasses, Keen, Steady, Weak, Shifty
SKIN	- Clear, Mottled
CLOTHES	- Excellent, Good, Fair, Slovenly, Over-dressed
CARRIAGE	- Unusually Erect, Normal, Stooped
SUMMARY GRADING *	- 5 - 4 - 3 - 2 - 1 - 0
b. SPEECH:	
DESCRIBE IMPEDIMENTS	- (Stammering, Queer Voice, Deafness) _____
VOCABULARY	- Excellent, Good, Average, Limited, Stilted
ACCENT	- Mid-western, Southern, Eastern, Foreign
EXPRESSIONS	- Well Chosen, Good, Common Place, Trite, Colloquial
DELIVERY	- Rapid, Smooth, Normal, Deliberate, Hesitant, Loquacious
SUMMARY GRADING *	- 5 - 4 - 3 - 2 - 1 - 0
c. BEARING:	
HAND SHAKE	- Firm - Satisfactory, Weak
POISE	- Exceptional, Moderately Sure of Self, Self-Conscious
MANNER	- Aggressive, Natural, Artificial, Timid, Afraid
PERSONALITY	- Radiant, Enthusiastic, Reserved, Overbearing, Blank, Glum
SUMMARY GRADING *	- 5 - 4 - 3 - 2 - 1 - 0
d. BACKGROUND:	
PARENTAGE (FATHER)	- Native born, Foreign born (Nationality)_____
(MOTHER)	- Native born, Foreign born (Nationality)_____
EDUCATION (FATHER)	- College, High School, Grammar School
(MOTHER)	- College, High School, Grammar School
FATHER'S VOCATION	- Executive, Professional, Clerical, Sales, Own Business, Tradesman, Laborer, Farmer
EARLY ENVIRONMENT	- Wealth, Middle Class, Poor
HOME READING	- Much, Some, None - Books, Papers, Magazines
TRAVEL - DOMESTIC	- Much, Slight, None
FOREIGN	- _____
RELIGION	- Active_____ Inactive _____ None
PRESENT HOME	- With Parents, Boarding, Married, Renting, Own Home
SOCIAL STATUS	- In Society, Above Average, Mildly Inclined, Not Interested
EARLY HEALTH	- Sound, Fair, Poor, Prolonged Illness
PRESENT HEALTH	- Good, Average, Below par _____
SUMMARY GRADING *	(For Work)-15-14-13-12-11-10-9-8-7-6-5-4-3-2-1-0

(Over)

* Interviewer should check off the proper terms and circle the gradings decided on.



in conversation. If he is honest and frank, willing to discuss himself impersonally, he involuntarily gives the essential information. Continuing the interview, the personnel director should guide the applicant also into a full display of his more intangible characteristics.

Check Lists

The figures show the interview form. On the first page are the check lists for the items of *Appearance, Speech, Bearing,* and *Background. Education* and *Personal Habits* follow on the second page, to complete the "Factual Items." Below them follows the list of these ten "Intangible Characteristics":

1. Aggressiveness
2. Ambition
3. Analytical Ability
4. Cooperativeness
5. Sincerity
6. Industry
7. Judgment
8. Leadership
9. Mental Alertness
10. Sense of Humor

The interview form provides a ready scheme of scoring. You will note that the factual items do not carry equal weight. Here are the maximum values for the six items:

Item	*Points*
Appearance	5
Speech	5
Bearing	5
Background	15
Education	10
Personal Habits	10
Total	50

In contrast to the above values, the ten intangible characteristics all carry a uniform maximum rating of 5 points each. Better let it stay uniform than to attempt a relative evaluation between, say, *Aggressiveness* and *Judgment,* or *Leadership* and *Analytical Ability.*

A perfect rating for both the factual list and the intangibles is 50 points each. An individual might be rated 41-35 or 37-42, but his rating is never figured as 76 or 79 total points.

Ratings Scales Not Perfect

One word of caution. Rating scales are far from perfect and certainly no better than their users. This scale is no substitute for poor judgment. Rather it is a fact-filing chart designed to simplify a difficult assignment.

e. EDUCATION:

SCHOLASTIC RANK - Upper 25%_____ 2nd_____ 3rd_____ 4th_____
COURSES FLUNKED _____
SPECIAL CLASS HONORS _____
CAMPUS ACTIVITIES _____
SOCIAL FRATERNITY _____ Technical or Honorary_____
SCHOLARSHIPS _____
VALUE OF EDUCATION - Worthwhile, Average, Mediocre

SUMMARY GRADING - 10-9-8-7-6-5-4-3-2-1-0

f. PERSONAL HABITS:

ACTIVE SPORTS - Golf, Tennis, Swimming, Bowling, Other_____
OTHER RECREATIONS - _____
READING - Much, Some, None - - Books, Papers, Magazines
SHOWS - Frequently, Occasionally, Rarely - Movies, Legitimate, Concerts
DRINKING - Habitual, Much, Moderate, Slight, None
GAMBLING - Frequently, Occasionally, Never - - Races, Cards, Sports, Gaming
THRIFT - Kind of Savings___Earnings in College___Outside Income_____
Debts___Dependents___Expected living expense per week_____
AUTOMOBILE - Make and Year _____ None_____

SUMMARY GRADING - 10-9-8-7-6-5-4-3-2-1-0

II. INTANGIBLE CHARACTERISTICS
(Grade each Item from 5 to 0)

AGGRESSIVENESS _____	(Did applicant take the lead in conversation? Did he persist in his own opinions? Is he a "Yes" man? Will he fight to get ahead? Or demand attention?)
AMBITION _____	(Ask applicant how far in our organization he would want to go? How hard would he work to attain this end? Is his ambition guided by a sense of purpose?)
ANALYTICAL ABILITY _____	(Ask applicant if he feels he has this quality. If so, why, and how has he ever demonstrated it. Was he good at Math? Has he apparently a high I.Q.?)
COOPERATIVENESS _____	(Is applicant agreeable? Is he selfish? Does he feel one man can dominate a whole plant? Ask him to define COOPERATION? Is he jealous of his education?)
SINCERITY _____	(Does applicant answer questions hesitatingly? Is he earnest in his approach? Will he look one in the eye? Is he eager to please? Is he 100% for honesty?
INDUSTRY _____	(Did he earn any money in college? Has he worked in the summertime? Will he begin work in our shops? Does he count money the reward for hard work?)
JUDGMENT _____	(Do his remarks and ideas reflect good thought? Does he use good judgment in dress and in his approach? Has he ever done successful work calling for decision?)
LEADERSHIP _____	(Did he show any of this trait in college? Is he a natural leader or a follower? Does he sell himself to you? Is he a positive person? Does he talk forcefully?
MENTAL ALERTNESS _____	(Does applicant appear unusually quick and bright? Do his answers reflect the spontaneity of a brilliant mind? Was his scholastic standing high? Are his eyes keen?)
SENSE OF HUMOR _____	(Does he smile often? Did he take the invetview extremely seriously? What kind of shows, books, and magazines does he enjoy? Does he get much fun out of life?

TOTAL POINTS _____

The Myth of High Wages

How easily employees are misled! Prosperity is actually measured, not by higher wage rates, but by yearly "real wages"—which is what money wages will buy in goods and services. To have more, we must produce more

HERVÉ SCHWEDERSKY
Consulting Economist

CONGRESS is now considering the Fair Labor Standards Bill of 1937 (S. 2475, H. R. 7200). There can be no quarrel with any sincere attempt to correct abuses and help some of the lowest paid workers. It is to be feared, however, that the measure in question represents but the latest attempt to legislate prosperity by legislating high wages and shorter hours.

Hourly or daily wage rates measured in dollars can be quite misleading. Money has no practical meaning until it is exchanged for an article or a service—until it is linked with what it will buy. A dollar is a variable quantity; its value, measured by its purchasing power, is constantly changing. It is for this reason that the economist has had to differentiate between "money wages" measured in dollars and "real wages" measured in terms of what those dollars will buy in goods and services. Employees have often been misled by high hourly wage rates while their prosperity is actually measured by yearly "real wages."

No More Purchasing Power

When we analyze the problem of the employer, we find him concerned with the cost of labor for each unit of goods manufactured or services rendered. If this unit cost is raised, he is compelled, all other things remaining equal, to raise proportionately the price of the goods he sells or of the services he renders. Under those circumstances a wage increase does not raise the purchasing power of the country. If it applied equally to all wage earners and salaried employees, then the cost of living would be raised proportionately and no one would profit. If it applied only to certain groups of workers, then they would profit at the expense of the consumers of the goods they made. In no case would there be an increase in the purchasing power of the nation as a whole.

First, Produce More

The economic reality that permits a real advance in wages is increased production and lower labor costs for each unit of goods produced or services rendered. A general reduction in prices resulting from improved manufacturing and distribution methods would represent an increase in the real wages of all workers; it would represent an increase in the purchasing power of the nation, for while the dollar income may remain unchanged, the volume of goods and of services which those same dollars will purchase will have increased. Such an increase in purchasing power would benefit everybody, even the lowest-paid employee.

When these various factors are clearly understood, it becomes evident that arbitrary limitation on hours of work will not raise the standard of living of the nation. It may succeed in spreading the available work among more people and may alter somewhat the distribution of the available supply of goods; *but it will not increase that supply* and in certain cases may even tend to curtail it by placing artificial restrictions on production and distribution.

It should be self-evident that in order to distribute more it is first necessary to produce more, and that all arbitrary restrictions, whether imposed by labor unions or by legislative bodies, place a barrier in the path of progress and of a higher national standard of living.

In view of this relationship between real wages and production, it is important to contrast the important increase in production due to new machines and better distribution facilities on the one hand, and the rapid increase in money wages which has taken place since the turn of the century. Such a study is presented here in the form of a chart showing the fluctuations in money wages, real wages, and the average volume of production per worker between 1899 and 1936.

For the period covered, *money wages* rose from a low of 68 in 1899 to a peak of 223 in 1929, an increase of about 230 per cent, while *real wages* rose from 89 to 133, a 50 per cent increase, indicating the extent to which the raises in pay were nullified by a resulting rise in prices. Of course, prices were also subjected to other influences during the period, such as the World War, tariffs, and shortages and surpluses in certain commodities, but the close relationship between real wages and production remains fairly constant during the entire period, with only minor and temporary variations. It is also worth noticing how real wages were maintained during the depression despite fluctuations in money wages.

Even Higher Living Standards

These indexes cannot cover every detail relating to such a complex problem. It is difficult to take fully into account such items as an increase in quality or style of an article, or the effect of new inventions, such as the automobile, the telephone, the movies, the radio, when comparing purchasing power today and 40 years ago. For this reason the index of real wages, which must be based largely on comparable goods over a period of years, must not be confused with an index of the standard of living, which improved at a more rapid rate. It does, however, reflect the purchasing power of wages when measured by the necessities of life, such as food, clothing, and shelter.

The indexes used in the chart

cover as nearly as possible goods actually produced and average wages received during the year without regard to the number of working hours. These decreased from about 60 a week in 1899 to 35 in 1934 and averaged about 40 hours during 1936. Therefore, the increase in money wages, real wages, and production on an hourly basis has been much greater than is indicated by the yearly indexes. In other words, the average employee has sacrificed a substantial portion of his potential earning power for shorter hours and greater leisure.

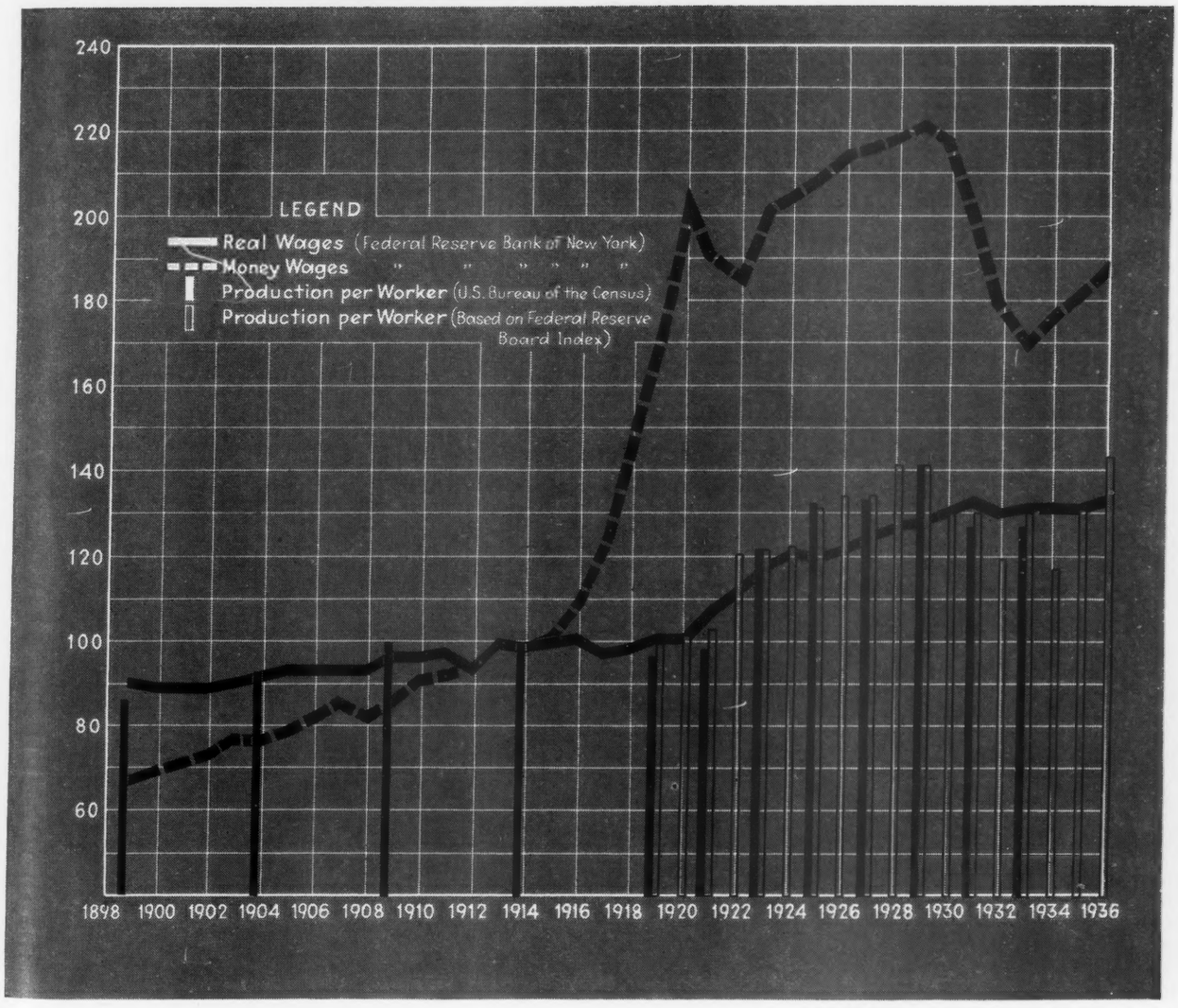
The chart and the figures quoted represent what happened in the nation as a whole, and show what the average American worker produced and received for his labor. The important lesson, however, is that during the last half century of progress covering booms and depressions, war and peace, while prices fluctuated and salaries and wages went up and down, but mostly up, *the purchasing power and real wages of the employed were measured not by pay scales, but by ability to produce.*

Strikes Haven't Helped

Their standard of living was not appreciably ameliorated by strikes, walkouts, or the efforts of labor agitators, not by wild-eyed theorists or deceptive panaceas, but by work of research engineers, inventors, and business executives who were able to translate inventions into an improved system for the manufacture and distribution of a constantly expanding volume and variety of goods.

As new machines and new sources of power became available, each wage earner accounted for more goods, and a corresponding increase in real wages automatically appeared in his pay envelope. It is, of course, true that all workers have not benefited equally. Gross inequalities in wages and profits have existed and still do exist. Most of these can and should be ironed out. Intelligent labor leadership could accomplish much in that direction. But let us not lose track of economic realities. High wages never bought the motor car before it was produced.

REAL WAGES, MONEY WAGES, AND PRODUCTION PER WORKER, 1899-1936
1914 = 100


240
220
200
180
160
140
120
100
80
60
LEGEND
Real Wages (Federal Reserve Bank of New York)
Money Wages " " " " " "
Production per Worker (U.S. Bureau of the Census)
Production per Worker (Based on Federal Reserve Board Index)
1898 1900 1902 1904 1906 1908 1910 1912 1914 1916 1918 1920 1922 1924 1926 1928 1930 1932 1934 1936

Foremen Write Their Own Training Tickets

Indiana concern questionnaires supervisors and foremen, bases training program on their votes

HOMER L. HUMKE
Director of Education, Servel, Inc.
Evansville, Ind.

FOR THE most part, foreman conference programs have been developed by directors of training, executive committees, and others specially able to undertake this type of development. A novel approach to the preparation of an outline for foreman conferences was undertaken recently at Servel, Inc.

During the past two years, foreman conferences had centered about the problems of departmental management. Essentials of managing men received considerable attention. This study naturally led to questions about the foreman himself. That the foreman really needed to make a thorough study of himself was a statement often made.

They All Voted

Near the close of the work last year, men who had attended conferences filled out a blank on which they listed the qualities needing consideration by a foreman. The ten qualities most frequently selected are shown in Table I.

Compilations were made from these questionnaire returns, and the accumulated data were submitted in a questionnaire to a large number of foremen and superintendents. This list was checked to indicate, in order of preference, the subjects that the men preferred to study during the coming year.

The ten topics favored as most desirable for the foreman training program for the year are given in Table II.

Qualities of a foreman, attitude of foremen, and personality were ranked first, second, and fourth in order of preference. Each of these three topics was related to the problems of the foreman's impression on others. It was decided therefore to attempt to tie up as many aspects of the other seven topics as possible with the general theme of "personality."

After a decision had been reached as to the content of the course for the coming year, meetings were held during the summer with conference leaders, superintendents, and key foremen. Here the details for the year's conferences were developed. Some tentative conference text material was prepared and presented in an experimental way by the director of education. Both material and method were critically evaluated. Attention was given to the possible units of work to be followed week by week, and the best sequence to use in presenting this material.

At the conclusion of this series of five conferences, the director of education conducted an extended series of meetings with the conference leaders for the purpose of bringing to them a background of the material and methods to be used in leading conferences on the subject finally selected. "The Foreman and Personality."

Will Watch the Results

The readiness with which the foremen accept, during the coming months, the program they have helped develop, will be watched with much concern. If the results are successful, as it is anticipated they will be, it would seem that practically all foreman conference work could be set up as the direct result of a careful analysis of the desires of the foremen. With slight modifications the same plan was used in making preparations for the conferences with group leaders.

TABLE I

Order of Selection	Trait	Frequency of Selection
1	Ability	54
2	Personality	43
3	Health	40
4	Honesty	39
5	Attitude	31
6	Cooperation	8
6	Knowledge	8
6	Leadership	8
7	Loyalty	7
8	Alertness	6

Other traits with fewer than six selections included habits, appearance, dependability, safety, initiative, judgment, conduct and ambition.

TABLE II

Topic	Rank (Rated Average)
Qualities of Foremanship	2.53
Attitude of Foremen	3.56
Cost Reduction	4.31
Personality	4.63
Job Analysis	5.9
Housekeeping	6.11
Scrap Reduction	6.57
Safety	6.63
Waste Reduction	7.3
Motion Study	8.0

Group Bonus for the Toolroom

Lower costs and quicker service for the company, higher wages for the men — are some of the benefits of this wage plan

C. B. GORDY
Detroit Editor

THE TOOLROOM is traditionally a daywork department, the usual argument being that the work is of such varying character that time standards would be difficult to apply, or, if applied, the effort would be greater than the benefits received. Yet the toolroom of the Graham-Paige Motors Corporation has operated on a group bonus plan since 1923 with benefit to the company and higher wages to the toolmakers.

Outside Shops

Automobile companies generally maintain tool and die departments which not only repair broken tools, but also make a considerable proportion of new tools. In addition, there are independent shops serving the industry, which bid for that portion of the toolwork which cannot be done by the automobile plants. Wages in the independent shops are higher than in company shops where work is more steady. The independent shops are able normally, however, to maintain fairly constant employment for a skeleton crew.

With this situation existing, Graham-Paige naturally wanted to work rates up to the independent shop level, attract better skilled workers, and thus be able to get tool orders through the tool department in less time. It was important when the plan was initiated to shorten the time taken in making tools in order to avoid investment in additional equipment and a consequent expansion of the tool department space.

No attempt is made in this company's plan to apply detailed time studies in setting the standard time. Instead, the print from the tool design department is given to an estimator. Based on his familiarity with toolroom methods, a time is set for the completion of the job, broken down into the time required by planers, shapers, etc. Of course this estimator must be thorough and competent, but experience has shown that time estimates can be made within less than 10 per cent of the actual time taken. In checking bids before the inauguration of the bonus, time estimates ran remarkably close to those made by outside shops.

Estimating is done by the foreman of the tool department. While this might at first blush seem to be open to question, it has worked successfully. The overhead is certainly less than if there were a man who did nothing but estimate. Two safeguards exist: First, the men are expected to make bonus, and if the estimates were actually lower than the possibilities afforded by the equipment, the purpose of the plan would be lost; second, spot checks are made frequently by sending tool prints out to contract shops at the time when the tool foreman estimates the same print. This acts as a safeguard against a too liberal estimate. Six jobs recently selected at random and so checked showed that our estimates of labor, burden, and material costs were considerably less than quotations received from outside shops on the same jobs.

First the Estimate

The estimator takes the tool print and makes his estimates as shown in Figure 1. One copy goes to the time office, another to the cost department, and the third is kept in the tool department. Time tickets are issued to the toolmakers by the toolroom office. These tickets are returned to the time office with the time worked stamped on them for pay records. A

TOOL ESTIMATE

Date _____ Tool Number _____

Description _____ T.O. No. _____

DETAIL NO.													Ass'y	Total Hours			
Shaper															Mat.		
Planer															Patt.		
Lathe																	
Boring Mill & Milling Machine																	
Grinder															Cast'g		
Drill Press																	
Bench & Harden																	

Remarks _____ Estimated

_____ Approved

Labor		
Spec.		
Total		

Figure 1. Made out in triplicate by the estimator, one copy of this estimate goes to the time office, another to the cost department, and the third is kept in the tool department

copy of these daywork tickets is returned to the tool office where, on a simple balance record (Figure 2) the time taken is entered against the estimate. This gives the toolmakers an accurate idea of whether some of their fellow-workers are exceeding the allowance. It also enables the foreman to pick out his slow men for instruction or for shifting to jobs for which they are better suited.

Figuring the Bonus

Estimated hours on completed jobs are totaled each pay period; actual clock hours on these same jobs are taken from the daywork tickets, and the difference is the bonus hours earned. The average departmental hourly rate applied to these hours translates the bonus into money. This bonus is then divided among the men in proportion to their earnings during the same pay period. Toolmakers are paid their day rate when the actual time exceeds the estimated time for an entire pay period. In the early history of the plan the bonus was split equally between management and men, but the estimates proved so accurate that the men were given all of it in order to make it attractive to them.

One man in the tool office takes care of the clerical detail necessary in addition to scheduling the jobs. The time office routine is not measurably increased.

Costs have decreased by this plan and it takes less time to get tools through the toolroom. With the simple balance record, the foreman is able, when needed, to state accurately the number of hours of incomplete work in the department. This aids in making promises on new tools and affords a means of increasing or decreasing the activity of the department as required.

Estimated Hours 54 — Inspector's O.K.

Order No. 50954 — Est. No. 2022 — Tool No. 104300-A

Tool- Fixture to assemble trim retainer to quarter panel, R.H.

Clock No.	Date	Hours	Accumulated Hours
67029	10-4-36	4	4
67038	10-4-36	3	7
67039	10-4-36	1	8
67035	10-5-36	7.5	15.5
67010	10-5-36	6	21.5
67038	10-5-36	1	22.5
67010	10-6-36	4.5	27
67029	10-6-36	4	31
67038	10-7-36	8	39
67020	10-9-36	5.7	44.7
67005	10-9-36	5	49.7

Figure 2. Time taken on a job is balanced against the estimate on this record. It shows where time allowances are being exceeded, which men are working too slowly

No Excess Men

Since there is a standard estimated time on each portion of every job, there is no opportunity for prolonging work without its coming to attention in short order; in other words, there can be no excess men in the department under this plan. It is interesting to note that nine out of ten times estimate of time required to make a tool is under that estimated by outside shops, while the average earned rate is close to that paid by them.

A gradual sifting process has taken place, men able to better the estimates have taken the places of those unable to do so, with consequently higher earnings. Less supervision is required; every time a man takes a job he knows the estimated time and whether those preceding his operation have made bonus. Hence pressure is placed upon the foreman to bring the slow workers up to bonus performance.

MATERIALS HANDLING

INDUSTRY faces a problem. It is how to hold down selling prices and retain profit in the face of rising costs.

Material prices are up. Labor costs are up and going higher. Equipment costs are increasing.

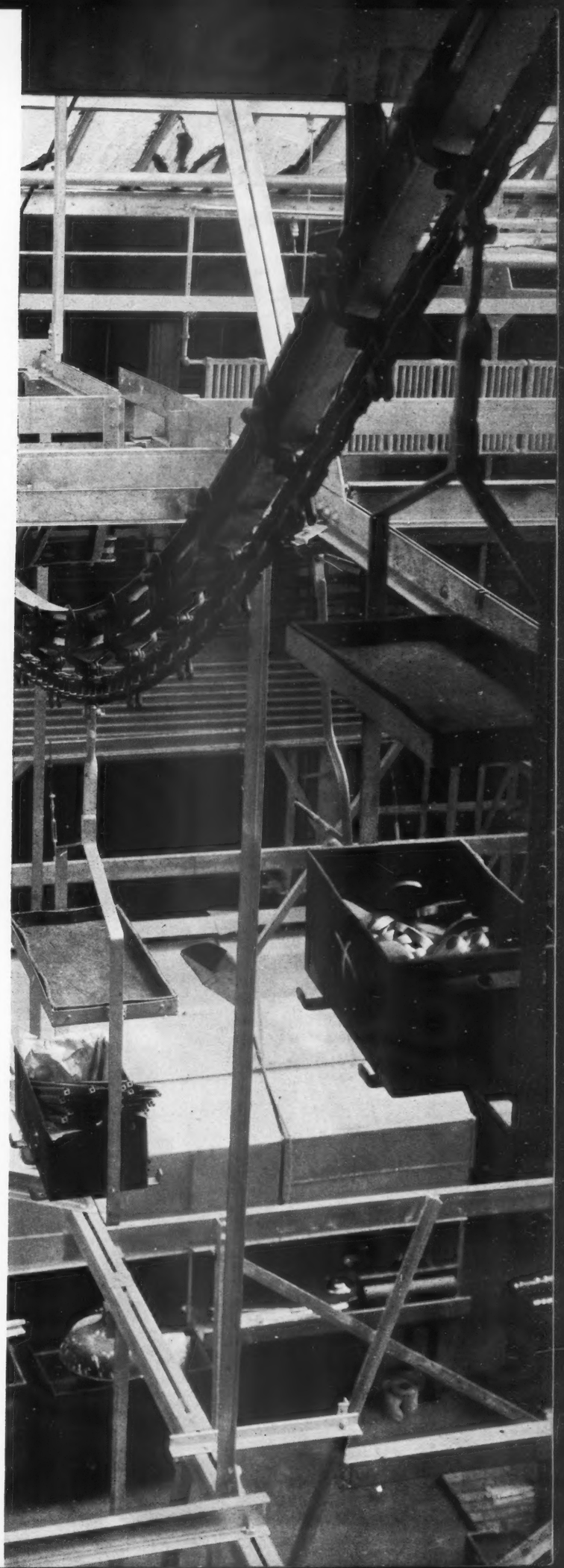
Passing increased costs to the consumer in higher selling prices is a risky solution to industry's problem. Direct competition is an obstacle. So is competition between industries. And so is the public's right to buy less.

There is only one solution. That is to lower production costs in order to absorb some or all of the increased costs of materials, labor, and equipment.

Cost of production is best reduced by full use of technological development in methods and equipment.

Particularly important at this time is economical handling. The higher the rate for labor, especially skilled labor, the more necessary it is to insure that labor is applied productively. The higher the cost of equipment, the more essential is its uninterrupted use as a productive tool. The higher the cost of materials, the more advantageous it is to minimize their time in process.

The proper application and use of materials handling equipment can be an effective preventive of a period of profitless prosperity.



WHEN YOU START FROM SCRATCH

Plan around the materials handling job that has to be done inside the building. That is the surest way of avoiding major mistakes in plant geography

FRANK D. CHASE
Industrial Engineer
Chicago

THE IDEAL way to set about designing a factory is to start with a piece of white paper representing a 10-acre field, or larger or smaller, depending on the size of the plant to be developed. Right at this point the planner begins laying out the plant in terms of production departments, stockrooms, and the materials-handling set-up which will tie the parts together into something like an integrated whole.

Parenthetically, let us take mental note that it is well to own, or have under option, a few extra acres. Presently we shall touch upon this subject in a little more detail.

Of course the operations of each department have been studied, and a large-scale development has been worked out showing each piece of equipment in relation to every other piece. Now, in and on our field we locate the various departments and the internal transportation. The relation of each department to the others is studied, and the plant layout begins to take shape. Templets of the equipment for the departmental studies and of the departments for their correlation are made. In our office we build tables 15 and 20 ft. long on which to play this game of chess. The result of careful advance study of all factors is not only a very large economy in production and equipment costs, but also reduction to the minimum of actual plant area, which means capital investment saved.

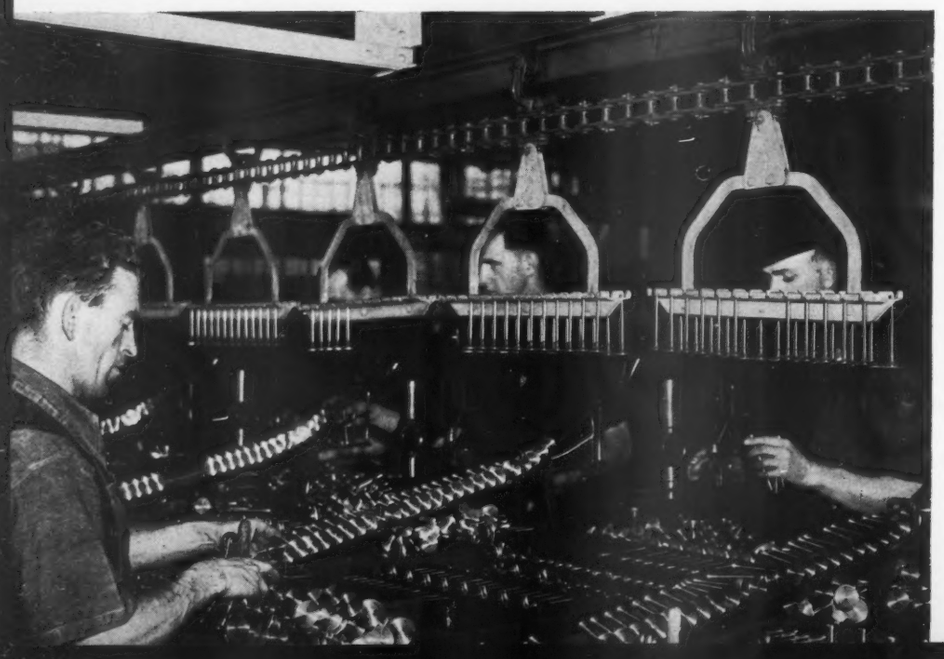
Where Handling Begins

During all this time, the problem of materials handling has been with us, but has necessarily been pushed aside in favor of production and stockroom problems. Now we have reached the stage where the problems of internal handling become both all-important and acute. To start with the incoming materials that arrive by railroad freight, we have to recognize that switch tracks take space and also that they cannot make right-angle turns. The switch-track approach is often a determining factor in the location of the plant buildings. On these tracks is the beginning of materials handling —that is, raw materials—and the end of materials handling—that is, the loading of the finished product. In between we must plan the materials handling into, through, and out of each and every department.

In predetermining the size and shape desired for each department, it is necessary to consider the problem of handling materials mechanically. First we must consider all the types of materials-handling equipment available for the task, and select those that will do most effectively the specific tasks we need performed. In placing the departments in relation to one another, it is likewise necessary to visualize them interconnected by internal plant transportation, whether this be belts, rollers, monorails, or conveyors—whether it be cranes, tractor-trailer trains, lift trucks, portable elevators, chutes, or any of the other invaluable aids to low production costs.

In brief, the whole series of operations must be laid out as it can best be correlated by the materials handling. The entire factory unit is spaced on our field in such position that future expansion will be merely a natural evolution of the departments and involve entirely simple extensions of the handling installations. Now, and only now, can we decide that it is time to put a roof over the place, and walls to curtain it from the elements and support the various facilities otherwise required, including whatever materials-handling equipment may be necessary.

Modern manufacturing is so intimately interwoven with mechanical handling of materials and parts and finished products that a factory



Machines at Ford's Northville plant are served by overhead chain conveyors, which also take completed valves to inspection. The men on the far side of the bench check for roundness, then roll the valves down the chutes to the inspectors on this side who check face of valve foot and inspect seat angle

must be thought of in terms entirely different from the old concept. It is no longer primarily a building, but rather the flow of work from process to process. The building, important though it is, is incidental to the flow. And the flow depends upon mechanical movement.

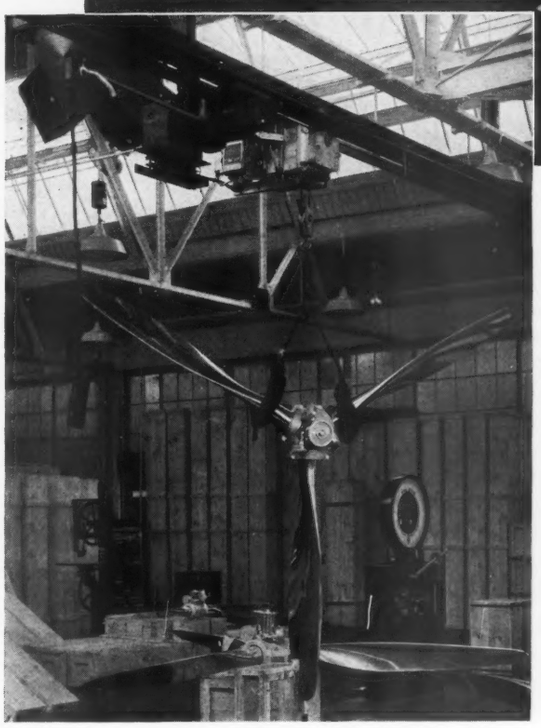
Out of long experience in factory design, I know that this is the one way to attain a factory that fits the task. When you start from scratch in factory design, this must be your approach to the problem. *Today's ideal factory is one that is designed according to process and materials handling rather than according to the conveniences or economies of bricks and mortar.*

Guarding Against Future Loss

Much of structural obsolescence in manufacturing plants comes because the designer—whether 100 years ago or 20 years ago or year before last—did not visualize the extent to which 1937 mechanical equipment would influence costs and profits. Much of the major depreciation in future years will come because plants that are being built today may not be designed with due regard for present and prospective trends in handling. We cannot know the future, but by knowing the past and present we can do a reasonably good job of guarding against losses that might arise from future developments.

The extent to which mechanical equipment for materials handling may influence processes and building design is not appreciated by one manufacturer out of ten—because he is not working with the technique continually. For example, a New England manufacturing plant had to have more production space. This could be had at the expense of the warehouse space on the premises, but actually the proposed increase in output would require more storage. And the plant was firmly hemmed in on both sides, between two other plants which had no need nor intention of moving. At the rear was a railroad track. Beyond the track was vacant land.

The solution was clearly dependent upon mechanical methods of moving the heavy completed product. Air rights were obtained from the railroad company; a bridge 125 ft. long was built at legal clearance over the right of way; an apron conveyor with cleated plates was installed to prevent the finished product from sliding or falling off on its trip. Actually, the conveyor runs more than 200 ft. from the end of the crating line to the storage across the tracks. Operating it, with due regard for maintenance and depreciation, costs about $2 a day. In other words, the handling tax upon this large business is $600 instead of $1,500 a year, which would have been the cost of trucking by a roundabout route to reach the warehouse across the railroad tracks.



No mass production plant is United Aircraft Corporation's new Hamilton Standard Propellers Division. There are no spectacular assembly lines. But the job of handling was always kept uppermost in the planning that preceded its erection. Propeller parts are moved to assembly benches on these convenient floor trucks; finished propellers ride the overhead rails to the shipping department

Designed for Handling

Moreover, the design of the warehouse was based upon conveying. The product is distributed to first and second floors, and later brought back to the shipping platforms by roller conveyors. Without them, we should have had to design a warehouse covering twice as much land, and requiring twice as much roof and foundations—not a negligible advantage in a warehouse of 100,000 sq.ft. built in a swamp!

Or consider a stove plant which we are right now completing for a stove manufacturer in Tennessee. Stoves start with very raw materials indeed. They require a wide variety of processes. The product is heavy and bulky. Which means, to the experienced engineer and architect, that the plant has more than an ordinary dependence upon good handling for low costs. This entire plant is designed around mechanical equipment for economical, efficient handling. And when it gets into production it will house about as diverse an assortment of equipment as ever we have designed into a production layout.

The foundry is, of course, entirely

Gasoline pumps are assembled, later crated for shipment, on roller conveyors at the Gilbert & Barker Manufacturing Company

mechanized, with the full complement of belts, chutes, chains, monorails, cranes, conveyors, and so on. An outside craneway uses both hand and electric equipment. A skip hoist charges direct to the cupola. Conveyors handle sand, melted iron, flasks, and castings. High-lift trucks carry the products into the warehouse; tiering machines stack them seven-high. Then at the time of shipment the handling sequence is reversed and the stoves go into the cars and are packed to the roof by high-lift trucks. Conveyors haul parts and sub-assemblies between departments. The mounting room —which in any other industry would probably be called the assembly department—is mechanized. Space limitations forbid detailing all the assorted handling jobs and machines employed, but when they are all teamed together, the result will be top-quality products at rock-bottom prices—because, of course, the plant was designed 100 per cent around good handling.

Linking Factory and Warehouse

In Michigan we are right now connecting a new plant warehouse with the old factory across the street. The problem was just about like the New England plant's, except that the obstacle barring the way to an addition is a busy highway. Much the same solution has applied here, modified to meet the differences in type of product to be moved. The savings effected by using this conveyor will meet the fixed charges of the entire warehouse development.

It would be possible to fill this entire magazine with examples of new plants, additions, modernizations, rearrangements—all designed around mechanical handling. But certainly the handful of instances already cited is sufficient to make my point. *You do not make major mistakes in layout, in building, or even in location if you plan around the job of handling that has to be done inside the building.*

Structure and handling are so inextricably intermeshed in the modern industrial architect's mind that it is hard for him to think of one without the other. But there are certain respects in which the building must be thought of as an entity by itself, yet in relation to handling.

Extensible Equipment

The first place where this must be considered when you start from scratch in planning a plant building is the possibility of expansion. Probably the most basic error made by the largest number of manufacturers in planning a new plant is that they think in terms of the present rather than the future. If the business is successful, if the trade territory increases in population, if consumption of the class of product broadens, if new lines are added, then some time this plant may be called upon to turn out more goods than the present structure can. The interest and taxes paid over a term of years for vacant land adjoining the plant total up to almost nothing in comparison with the cost of moving to a new plant.

But the problem is not solved merely by having extra land. It needs to be on those sides of the building that permit natural growth with a minimum of tearing up. The plant departments need to be so situated within the factory that they can, ideally, be extended merely by building a new structure outside their walls and knocking doors or craneways through. The handling systems should be such that when the extension goes into production, no major change of handling is needed. In brief, the building and the handling equipment should be extensible.

Likewise they should be flexible for future rearrangements and relayouts. Today's product requires a given flow. Ten years from now it is conceivable that your buggy-whip manufacturer will be turning out carburetors, and his flow may be opposite or at right angles. If the plant is laid out with such contingencies in mind, the handling problem of the future will be greatly simplified—and 1947 costs will be heartily reduced.

Right Plant Geography

All of this harks back to what I said in the early paragraphs of this article. You get the right plant geography when you consider the factory as merely a housing for departments and the flow of materials between them. Correct geography means lower costs and better products. These, in turn, mean larger sales and steadier profits. In the long run it all depends upon laying out the new plant to permit the best possible handling that today affords, likewise to take advantage of any major improvements the future may bring. And if the future may be fairly judged by the past, we may confidently expect that engineers and equipment makers will provide steadily better and more efficient methods of materials handling for a great many years to come.

WHEN YOU MODERNIZE

Use layout, handling, and motion economy to help you arrange plant and machines around the natural flow of materials

ALLAN H. MOGENSEN
Consulting Editor, FACTORY
Industrial Consultant

From four floors to one. Every step of Cadillac's revolutionary job of revamping its production facilities was worked out like this by John A. Buser and others on the company's engineering staff. For complete description of this outstanding job of modernization, see Mr. Buser's articles in *Factory* for April and May of last year

IT WOULD BE interesting to hear the private comments of some of our industrial executives today, when, after continuous efforts to make work easier and to simplify production, they find themselves charged by labor organizers with "speeding up production to a point beyond human endurance." When one sees the amount of mechanical handling equipment that has been installed, and stops to realize just how much backbreaking effort it has eliminated, one wonders just what the charges against management by these professional trouble-makers would be if none of it had been put in.

In fact, in one of my client's plants the other day we were discussing fatigue, and one of the executives made the statement that he did not think that there was a single job in his plant that could be called fatiguing. Although I did not entirely agree with him, I was forced to admit that there was hardly a place in the plant where any operator was required to lift or carry an object as heavy as the suitcase I lug around with me all the time.

Also, at the Institute of Management the other day, Dr. H. W. Haggard, of Yale University, pointed out that we had simplified so many of our jobs that the problem in many cases was not to provide rest for the operator, but to devise some means of variation in the motions followed that would permit sufficient exercise to keep the circulation of the blood up to the proper point. In other words, in many cases the problem is not one of eliminating fatigue, but of furnishing the operator with sufficient exercise to prevent him from falling asleep.

Two Main Driving Forces

Nevertheless, there are many plants where much lifting, carrying, bending and stooping do indicate study for improvement, and the manufacturer today has two main driving forces to encourage him in this direction.

One is the ever greater need for cost reduction. With raw materials costs mounting daily, and labor costs going up due to increased wage rates and the general tendency that is becoming more and more apparent in many plants—that of voluntarily restricting output—and this is by no means confined to the automobile plants where the organized slowing down of the assembly lines is presenting a major problem—these conditions are narrowing the profit margin that in many cases was none too wide.

The factory manager is therefore confronted with the dual responsibility of getting production costs down in the face of these rising costs, and yet not antagonizing the men, who are constantly being told on the outside that they are being forced to work too hard.

One way to appeal to the employee's interest is to let him see that we are trying to make the work less fatiguing. This may mean studying the layout of the individual workplace, or of the plant as a whole. Now perhaps the reader has read the preceding article on "When you start from scratch," and said, "Yes, that would be swell, but I cannot justify a brand-new plant now, or even a major plant reorganization."

This is not written, however, with a new plant or a major reorganiza-

tion in view. Instead, it is directed to the manufacturer, large or small, who may have adequate plant facilities if only they can be arranged to permit efficient manufacture. Plant layout and the relative location of machinery and equipment within the department is a fundamental problem encountered in the search for low costs. This problem is of such vital importance that entire factories have been completely remodeled to bring their machine layouts into line with modern factory practice.

Industry in general falls between two extremes. At one end is the type of plant that produces simple products like rayon, salt, cement, ammonia, glue, or else complex parts such as automobiles, radios, washing machines and refrigerators. This plant is lined up to produce one or a few models. Once it has been set up, it resembles one big piece of production machinery that concentrates on a single product.

At the other extreme is the plant that typifies the majority of our industries. It manufactures a variety of products that do not permit of any specialization in either machines or men, and is continually called upon to meet entirely new problems and new methods of manufacture. As a result, it is usually laid out and equipped with machines for very general purposes.

Now there are two distinct methods of departmentalization. One is to arrange machines according to processes to be performed; the other, to the product produced. It is up to the production executive to find out how he can obtain all the advantages of the product control method of manufacture with as few as possible of its disadvantages.

Flexibility the Answer

The answer to many of these problems lies in a new and unthought-of flexibility in layout and mechanical handling. It has always been easy to make an elaborate mechanical handling set-up where it was to be a permanent one. In fact, some of these permanent set-ups reach an almost unbelievable perfection. For example, I was much impressed by a recently made layout that I had occasion to study. It is in the plant of a large concern that is faced with the problem of getting out tremendous quantities of merchandise each day and on that day as ordered by the customer. For many years these people have used mechanical handling, but largely to connect existing facilities, leaving the individual facilities as they were.

When Pro-phy-lac-tic Brush Co. modernized its shipping room, operations were conveyorized. Stock is stored on roller sections, packed on the main conveyor that winds into view, moved along it to the shipping platform

Now they have made a three-dimensional layout of the whole plant, not as it can be expediently put together, but as it should be to transport the goods from each source in the most effective, least expensive, and least fatiguing manner. It must provide flexibility enough to go from normal daily capacity to eight or ten times that amount in peak periods, and work effectively at both extremes.

One plant now reports that it can move a machine tool for well under $10. This has meant a new type of plant wiring, to permit rapid yet permanent and safe connections for power, and in other cases plants are actually going to the sort of plant wiring that permits plugging in a machine just as quickly and easily as one expects to plug in a waffle iron or an electric razor.

In other words, instead of regarding the location of machines and handling equipment as a local and more or less expedient problem, I feel that we shall have to look at the problem largely from the product point of view. Not how are we going to get it from one department where we have always done this operation on similar type of work, to the next one, but what is the ideal layout for the process, regardless of the quantity we are going to produce? "Here is the job to be done. Where can we locate it?" Let's get smart, then, and find out just how we can do it economically, making as few modifications from the ideal as possible.

One place where still more can be done is in proper machine grouping. In the mass production shops a good deal has been accomplished along this line, but as far as the general purpose or job shops go, it is regarded as beyond them. This is not true, and intensive study should be made of all operations to see just where logical groups exist, where one man can conveniently and with little fatigue operate more than one production machine.

Management's Fault

One of the main irritants to labor today is the failure to have sufficient parts to permit continuous operation. This responsibility falls straight upon management's shoulders. If the operators are on piecework or some bonus plan, hold-ups naturally result not only in loss to the company, but to the employees, as well. Such delays are a constant source of irritation to the operator, and can be prevented. Here, of course, the tie-in of plant layout, mechanical handling, and production control and planning becomes evident. I like to compare the con-

Rubber footwear manufacturers were probably greeted with choruses of "It can't be done" when first they insisted on conveyorizing their assembly operations. But, with the aid of the equipment manufacturers, it has been done with customary benefit to company, employee, consumer

tinuous method of manufacture to a rubber tube. You shove something in at one end, and one of two things happens—either something comes out at the other end, or the tube bulges in the middle.

With the process type of manufacture, especially with the antiquated systems of paperwork that we usually find in operation, it is easy for work to get lost between departments or actually in departments. One plant, operating under the customary process control method of manufacture, recently completed an order for a customer, although not on time. However, the manufacturer found on taking inventory at the end of the year that he had $12,000 worth of miscellaneous parts on hand, and of course the customer did not want them.

Outside influences are making the worker more critical of the management for whom he works, and if we are to keep him satisfied we must furnish him with adequate supply of parts and materials, timed so that he can work uniformly and at the proper pace, without undue exertion, so that he can develop the requisite skills in as short a time as possible, and become an efficient producer.

We must consider the productive process as a unit. We must at all times remember that the entire plant is a unit, no matter how many buildings it occupies, or how many different departments are set up within the plant. We can break each part of it down for the fine analysis, even to the point of motion study where it is justified, but we cannot overlook the fact that we must consider the beginning and end of the process as the limits of the overall production time. In many assembly operations and other group work I have seen what would otherwise be a fine set-up spoiled by a lack of balance on the part of one of the operators in the group.

Question Every Move

When we get down to handling itself, we must question every single move. First of all, is it necessary? If so, and if every endeavor has been exerted to eliminate the need for handling of any sort, we look for backtracking. This is the easiest form of handling to eliminate, as its very nature indicates that it can be improved. A flow chart immediately reveals backtracking, and suggests means of correction.

Next we look for heavy lifting or carrying. Despite the improvements that have been made on this score, there is still too much of it.

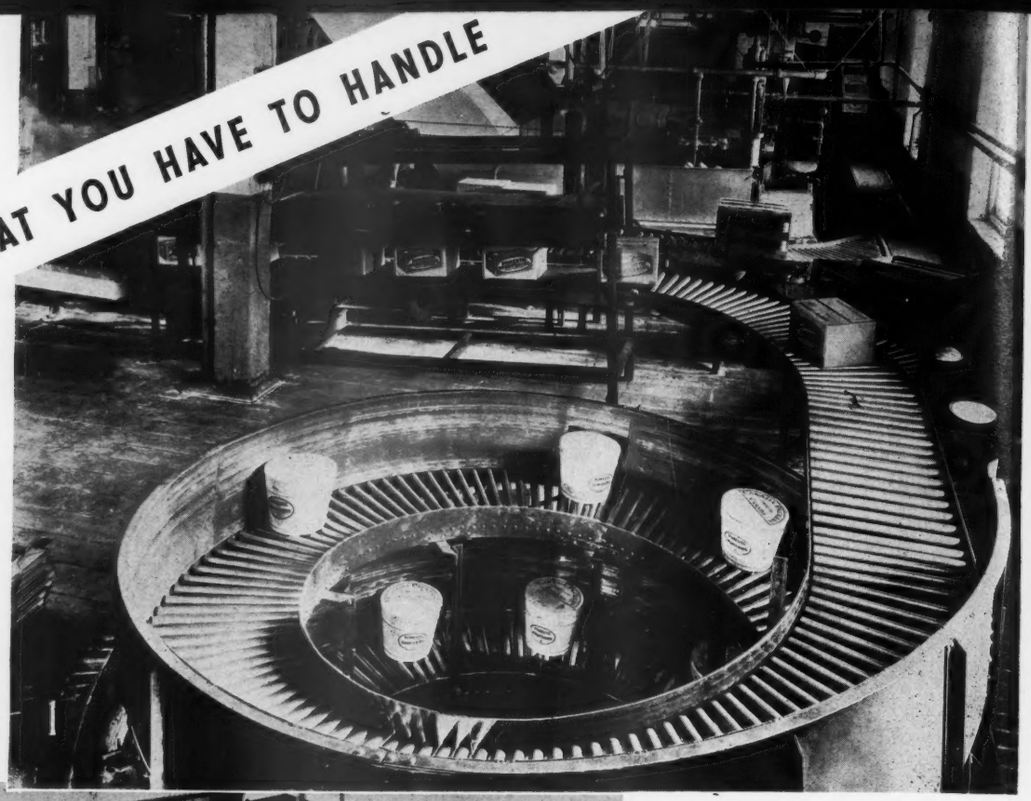
Another thing we look for is bottlenecks. Your plant can be operating 99 per cent effectively, but if you have a bottleneck anywhere, it will slow down the flow of material in your plant—and no unit is any better than the slowest one.

Another place to look for savings today is in skilled operators doing handling work. In many plants they tell me that they have only one trucker in the department, so that the question of handling is a minor one. Study shows at once that each operator is doing a large amount of handling. Of course, this is included in the rate paid for that job, or else he is penalized and naturally is a dissatisfied worker.

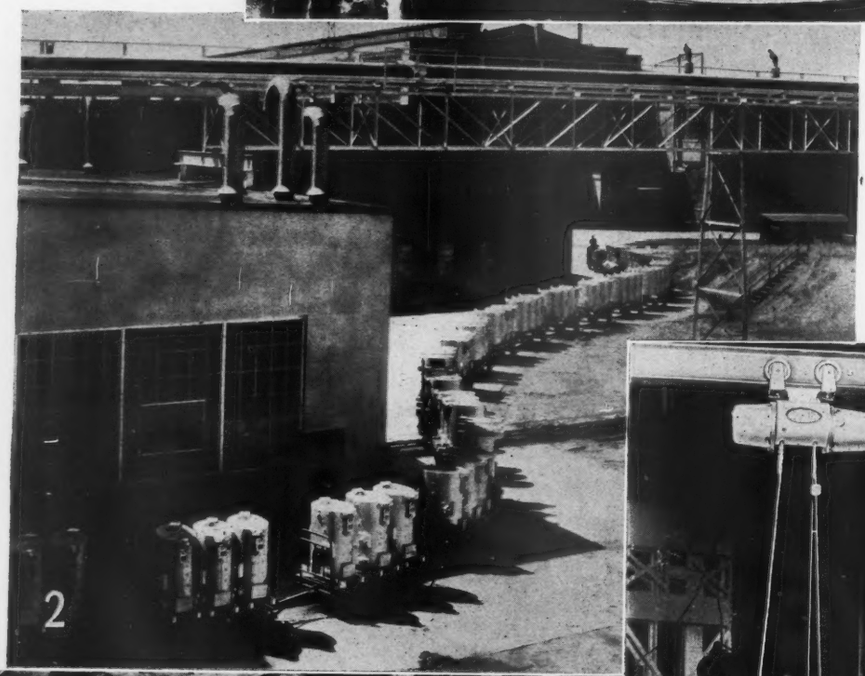
One plant I saw recently allowed 25 per cent for handling in the regular piece price. Just take 25 per cent and add it to your labor costs at the present rate, and you see what an important item this might be. If there is handling to do, perhaps it might be better to set up the layout of the department so that less skilled people are doing it.

In general, we should use all mechanical means possible where handling is necessary. We should keep material moving in one direction. And we should use proper loading, unloading, and stacking. When we grasp the real conception, the principle of continuous flow becomes the key to the most effective operation. The plant and its machines are then arranged around the natural flow of materials, instead of moving the materials from one point to another, regardless of where they are.

NO MATTER WHAT YOU HAVE TO HANDLE

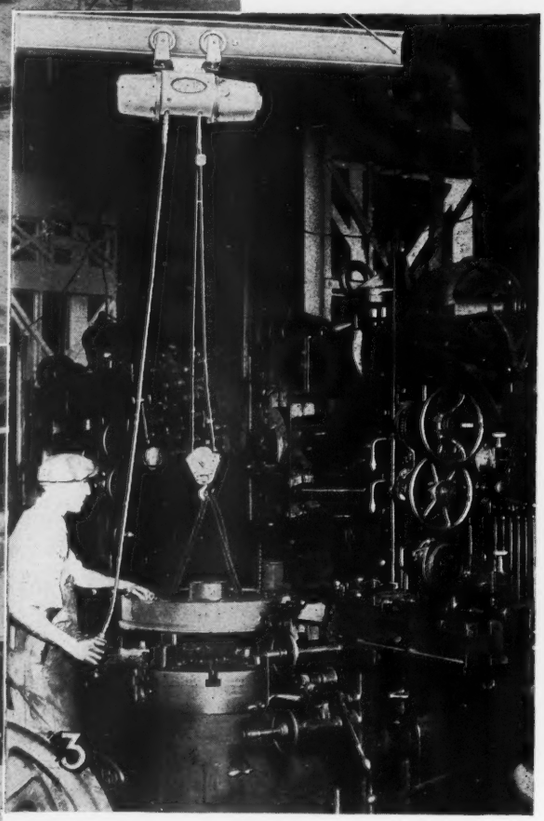


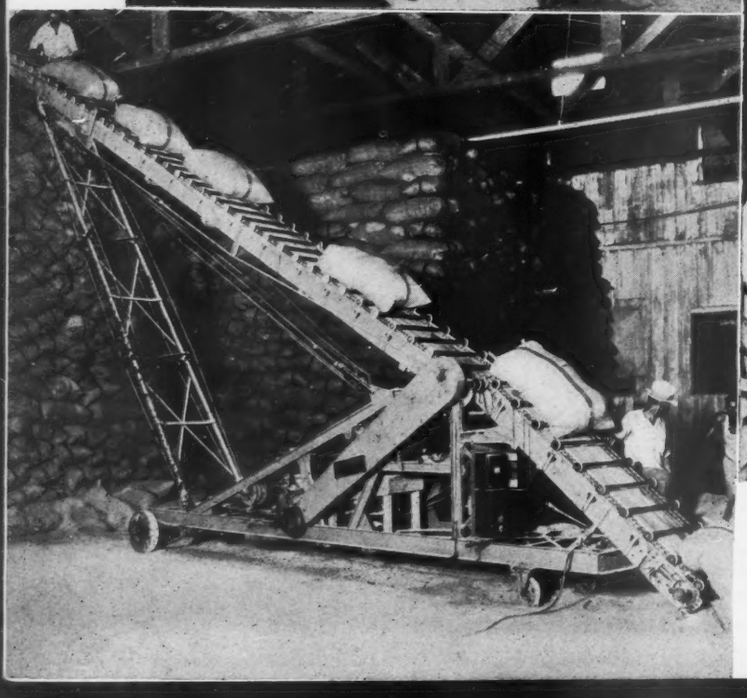
1. SHORTENING — tubs and cartons pass through sealing unit, spiral to storage on gravity rollers (Mathews). Or, if for immediate shipping, the section at the end of the sealer is replaced by another hinged section that curves in the other direction and carries cartons to the belt conveyor in the right background



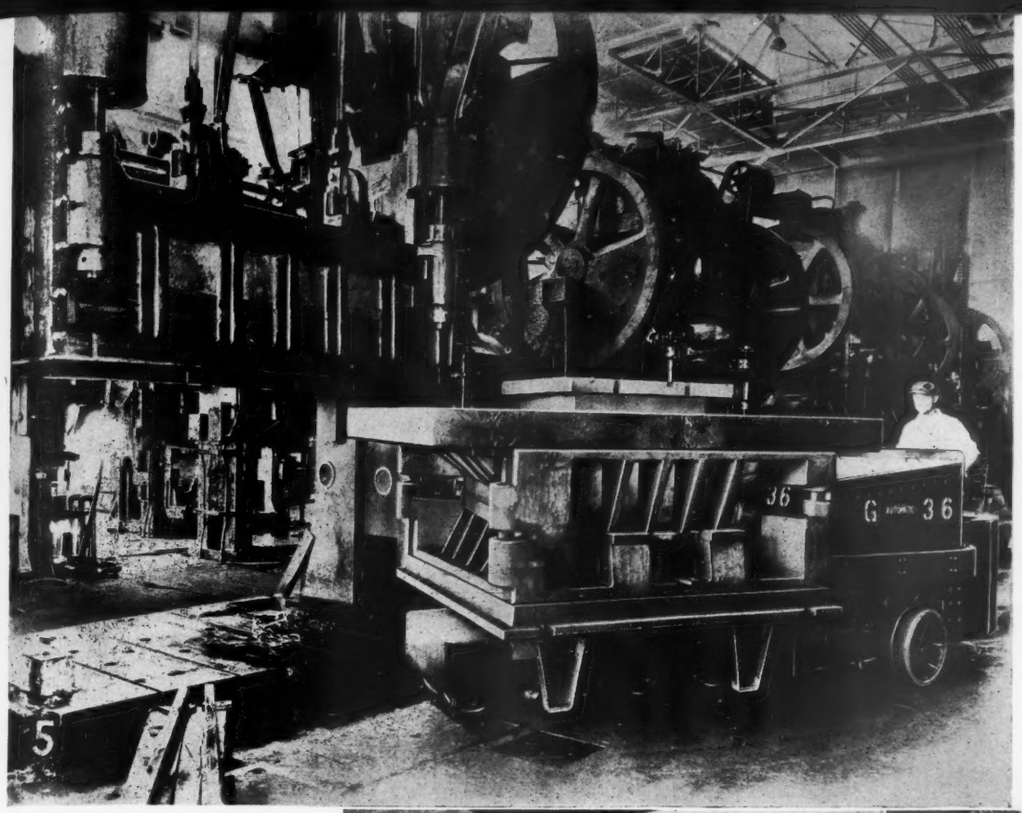
2. FURNACES — one tractor (Mercury), 20 trailers, 60 furnaces. No stunt. Part of the day's work for a heavy-duty yard tractor

3. WHEELS—machinist with hoist (Harnischfeger) makes light work of lifting heavy wheel into position on vertical boring mill





4. SUGAR is stacked 30 ft. up with portable piler (Standard), which is easily moved and put to work in any other part of the mill



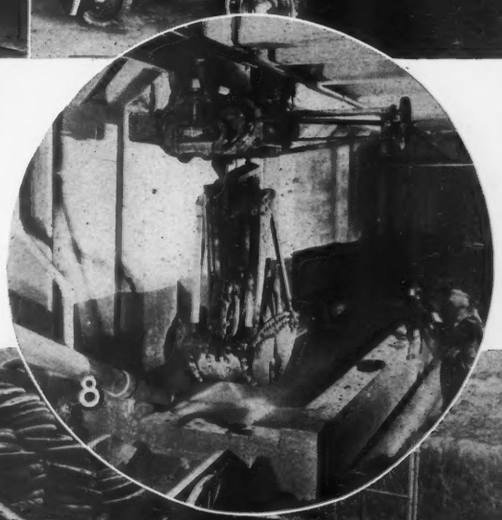
5. DIES — heavy handling like this is pie for the low-lift truck (Automatic). This one was specially designed to maneuver huge automotive dies weighing up to 30 tons

6. LYE — skid and hand lift truck (Colson) provide an unbeatable combination for the many short hauls that abound in the average industrial plant

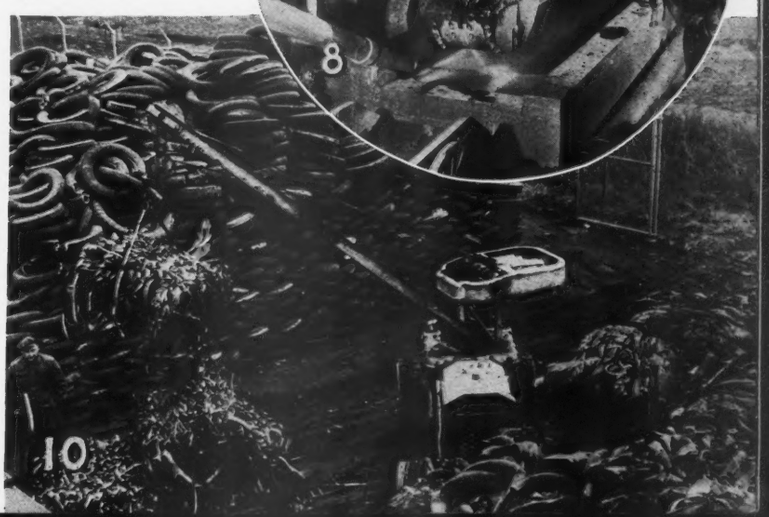
7. STEEL STRIP — one man might be able to roll these coils, but three or four men couldn't stack 'em. Power truck (Towmotor) handles two at a time, stacks with ease and celerity

9. WHISKEY must be aged. Portable tiering machine (Lewis-Shepard) goes to job in rack house. This one has welded frame, electric hoist

8. CINDERS are removed from sump in clamshell bucket on overhead trolley hoist (American Engineering). For operator's convenience, outboard control



10. RUBBER — to cope with peak handling loads, this industrial tractor (International) with crane



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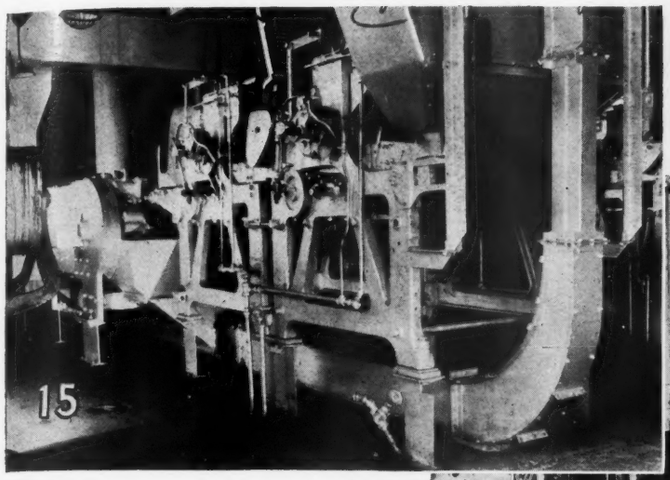
11. DOUGH in big troughs is handled on an overhead system (American Monorail). Here the dough has been flopped into the trough, is being weighed before going into the fermentation room

12. SEEDS — overhead chain conveyor (Lamson) with special trays keeps stock on the move. Order pickers have only to stand in their tracks, pick out packets as the trays ride by

13. MISCELLANEOUS products in bags, barrels, boxes, and crates are moved up and down on this labor-saving tray elevator (Gifford-Wood)

14. GENERATORS are shipped strapped on pallets. This power truck (Mercury) is used to unload car, remove pallets to storage, stack them till wanted

15. PEANUTS — three Redler conveyors (Stephens-Adamson) collect surplus peanuts at candy bar machines, move them in mass to hoppers for recirculation. Peanuts are handled so gently that they don't get broken. Enclosed conveyor protects them from any possible contamination



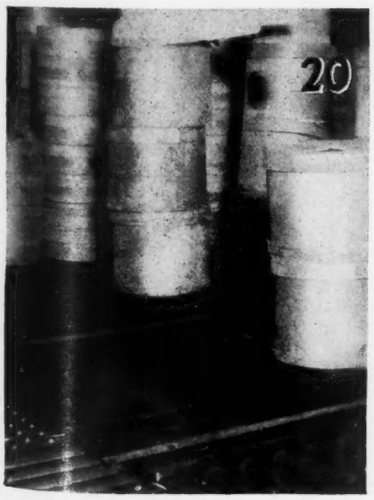
16. FORGINGS and stampings are conveyed via power lift trucks (Towmotor) in this automotive parts plant

17. OIL — while one line of roller conveyors (Standard) delivers empty oil cans to filling machines, another moves up empty cartons. Cans and cartons meet at precisely the right moment, the cans go into the cartons, and the finished product moves off to storage or shipping

18. LUMBER — a 10-ton crane (Whiting) with special lifting grapples handles big loads quickly and conveniently

19. SUGAR goes to storage on tramrail (Cleveland) and cab-controlled carrier, with 30-ft. lift at 60 ft. a minute

20. CHEESE — ball plates and rollers (Logan) provide moving storage plus simple means of sorting product into its various grades. This cheese factory is fully conveyorized. Its records show a 60 per cent savings in labor costs, accelerated production, savings in floor space, reduction in labor turnover



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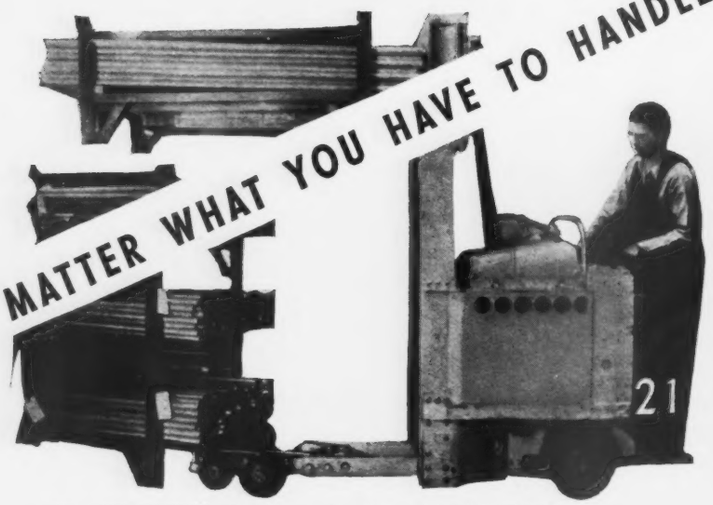
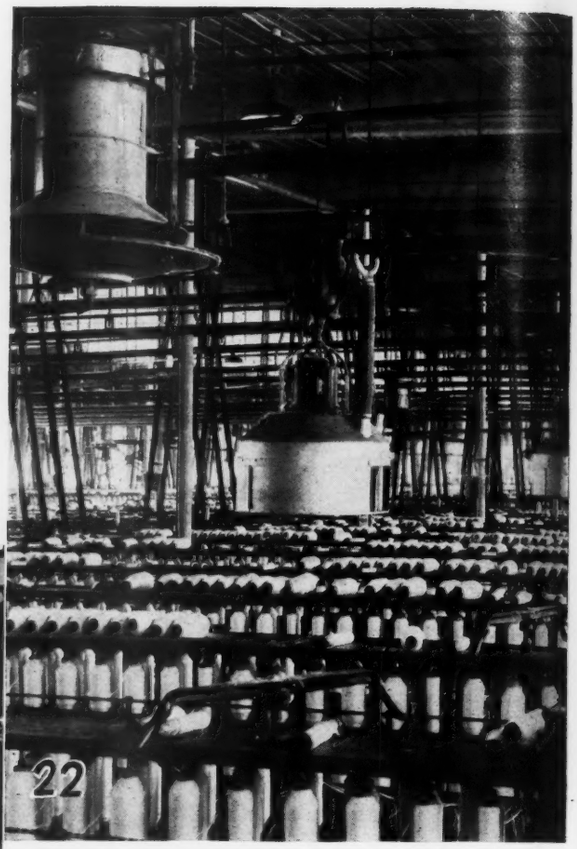
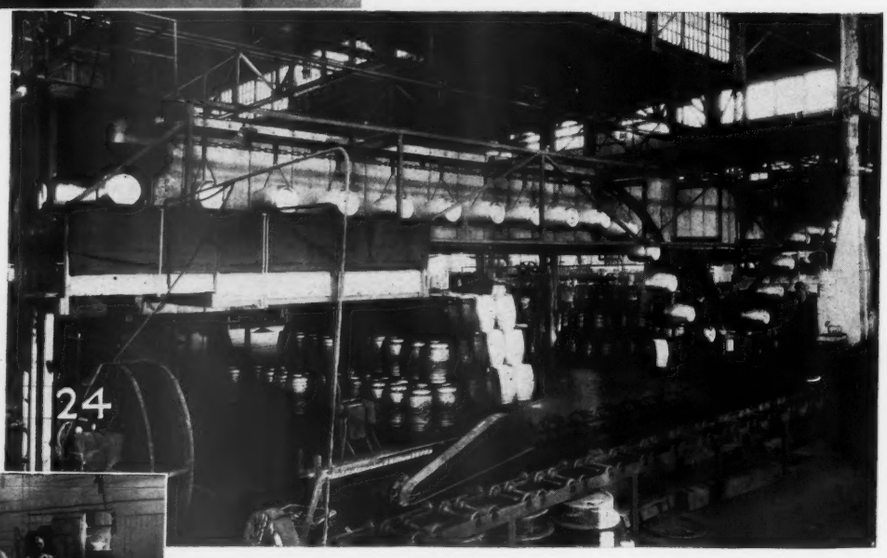


21. CONDUIT—platform truck (Elwell-Parker) stack racks, quadruples storage space. Racks have legs that nest to form stable tiers



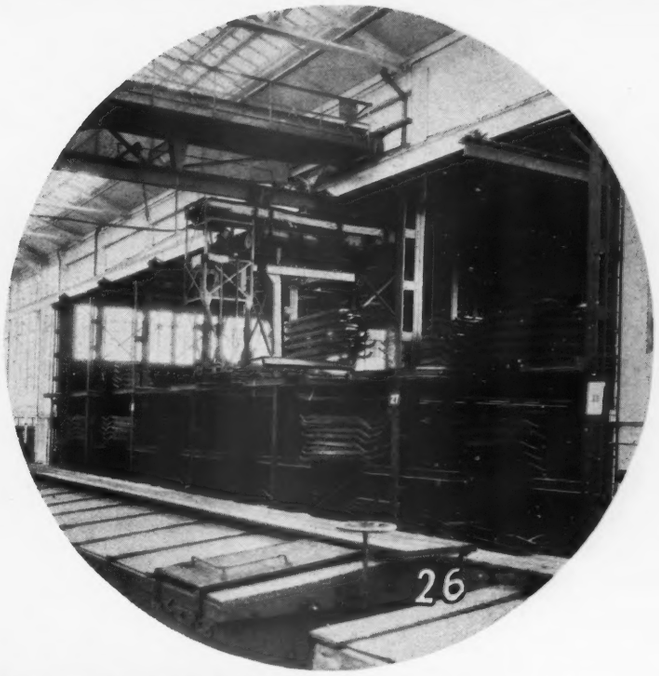
22. LINT — blowers travel on monorail systems (American) over creels of spinning frames and prevent lint from accumulating around spindles and bobbins. Another of the unusual jobs that handling equipment is called upon to do, and does so well

23. HAIR TONIC moves through bottling, packaging, and packing operations via belt and gravity roller conveyors (Lamson). Filled cartons in foreground are chuted to sealing machine

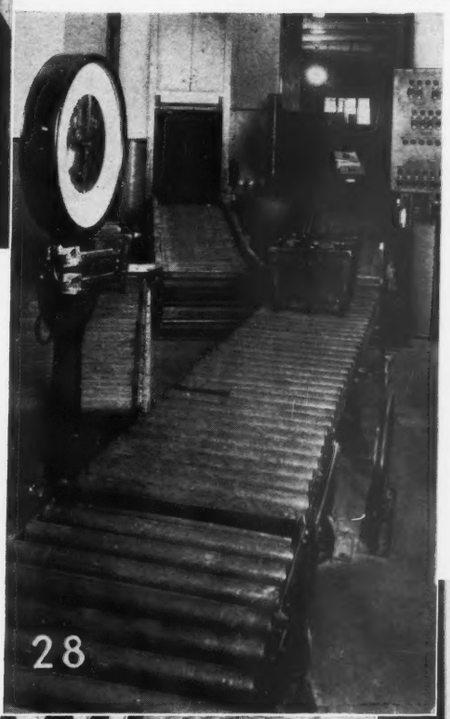


24. BARRELS are handled through painting and drying on overhead chain conveyor (Chain Belt), which enabled manufacturers to elevate drying oven and conserve much valuable floor space

25. MIRRORS are silvered at far end of steam-heated belt conveyor which is timed so that the chemical deposition is completed when the plates reach the near end. Mirrors are then transferred to slat conveyor at right which moves them through rinsing, drying, spraying operations. This installation (Jeffrey) increased capacity from 5,000 to 8,000 sq. ft. per day of uniformly better mirrors, and with but half the old working force



26. FRAMES — a 5-ton transfer crane (Harnischfeger) with 72-ft. span handles 10 automobile frames at a time



28. BOTTLES are weighed on the move, then dispatched over a two-way switch via live rollers (Logan) to any part of the 10 acres of floor space in this pharmaceutical plant. Note pushbutton control and signal lights that indicate exact movement of each tote box

27. PAPER in 4,000-lb. rolls is moved and stacked by means of multi-lift, tilting-fork truck (Yale & Towne)

29. CONCRETE PIPE — from kiln to storage, from storage to cars by this diesel-powered tractor (Caterpillar) and giant trailer

30. PISTONS and other small automotive parts are moved in box trucks (Colson) from one machine to another and finally proceed via chain conveyor to packaging and storage

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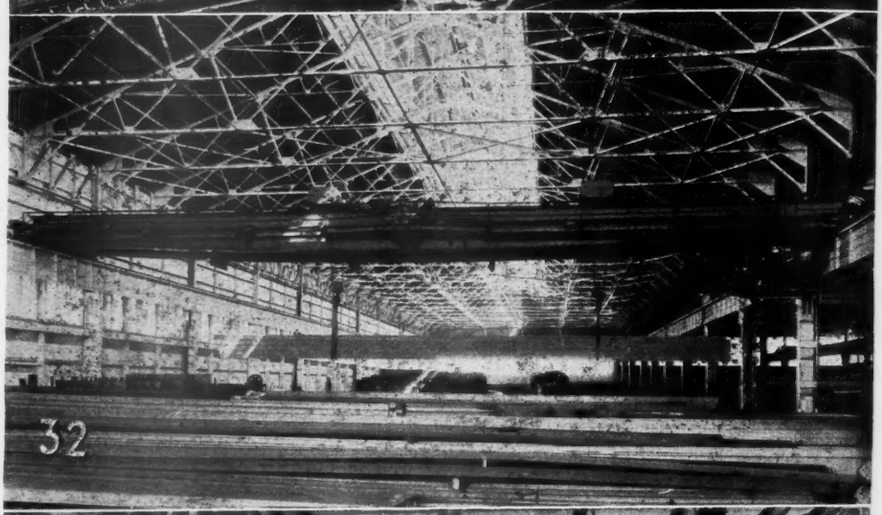
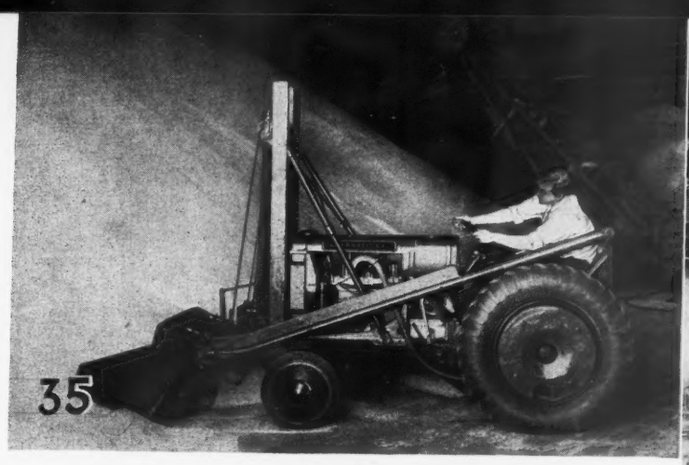
31. SAND is delivered by overhead belt conveyors (Link-Belt) to hoppers over molding stations in brass foundry. Flasks move to and from stations on gravity roller conveyors



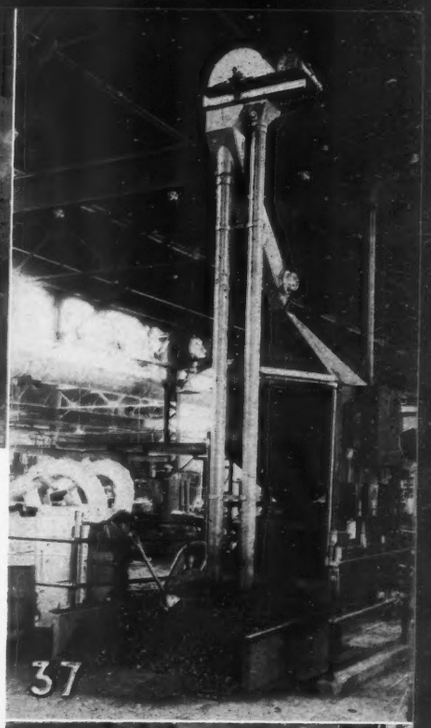
32. STEEL — a steel warehouse has constant need for an overhead traveling crane to handle the great variety of shapes and plates that are forever coming in or going out. This 15-ton crane (Whiting) covers a span of 100 feet

33. TIRES — via run-around floor conveyor in conjunction with overhead equipment. This installation (Jeffrey) very nearly doubled production with half as many men

34. CARTONS — into the freight car on skid and hand lift truck (Yale & Towne) at this paper box factory

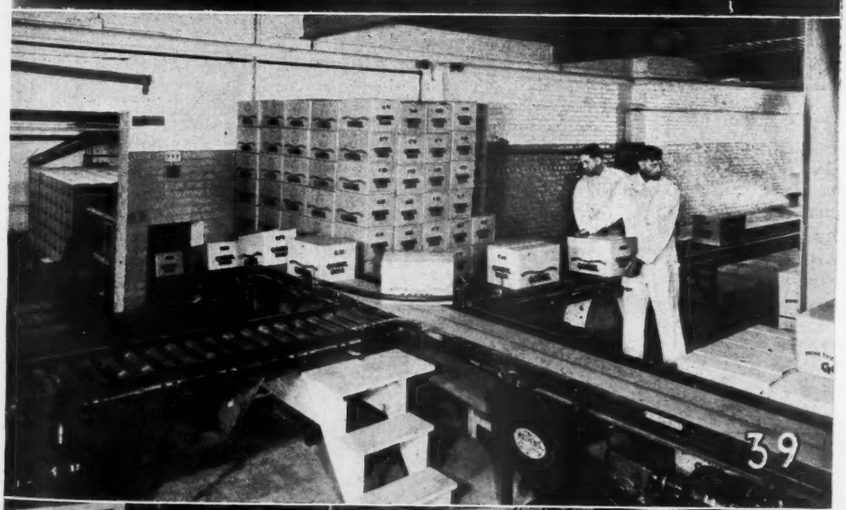


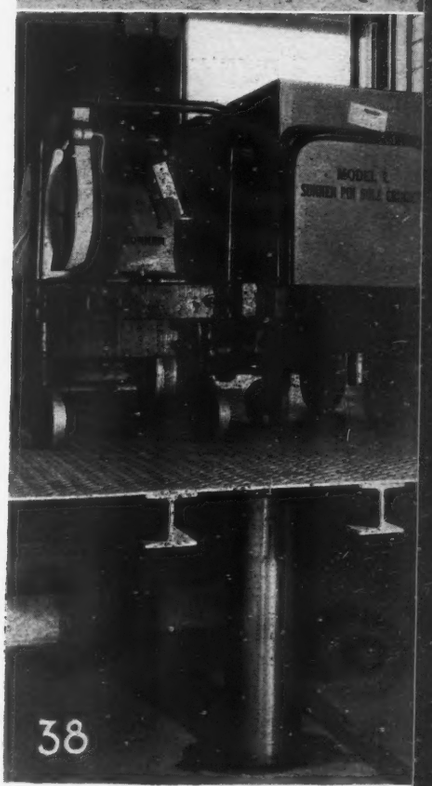
35. SALT — from stockpile to freight car by industrial tractor (International) and special corrosion-resistant steel shovel



37. COAL is automatically elevated via Redler conveyor (Stephens-Adamson) from storage pile to pulverizer bin. When supply in bin runs low, the elevator goes to work

36. BARRELS are handled and stacked easily by one man and high-lift truck (Baker) equipped with special barrel prong



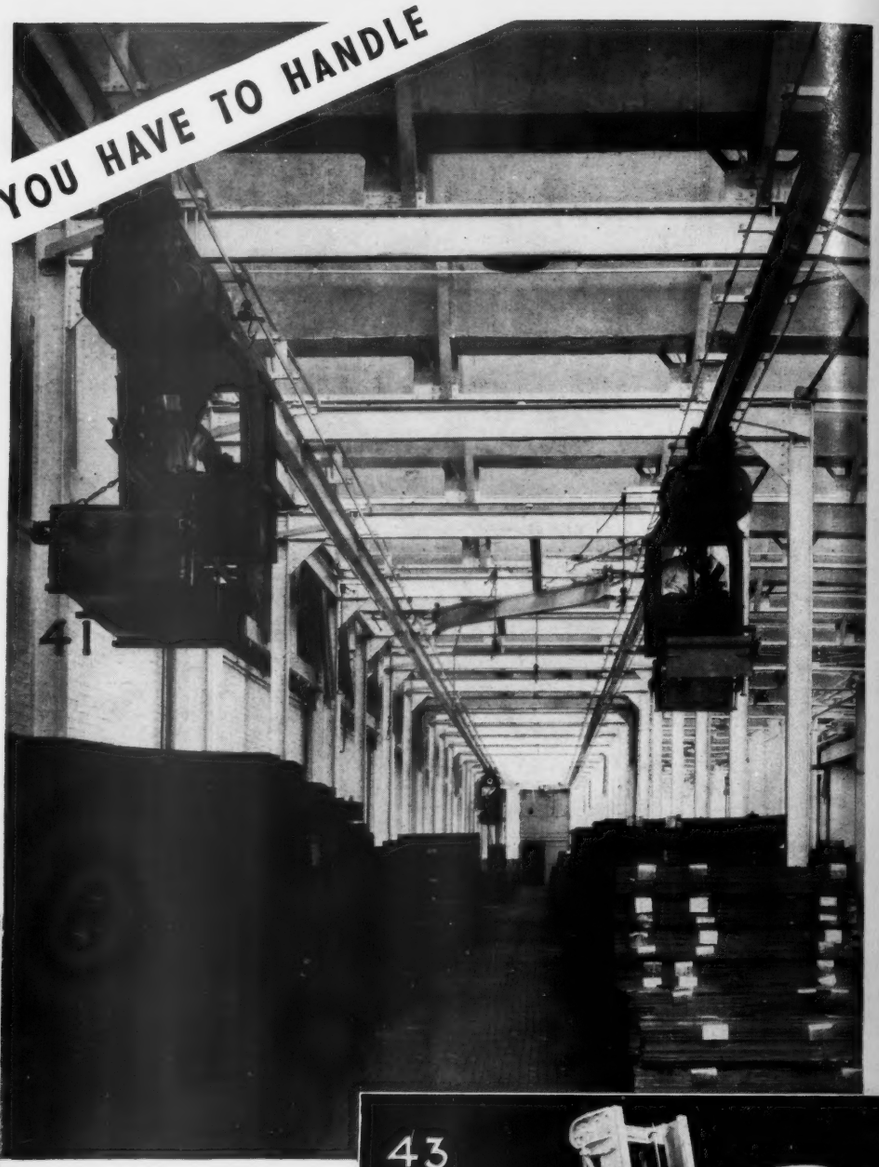


38. GRINDERS on floor trucks are lifted on this hydraulic elevator (Curtis) from factory floor to shipping platform

39. BEER in cartons is elevated via belt conveyor to storage, deflected in either direction on live rollers. Installation (Mathews) is reversible, takes cartons from storage to spiral chutes which lower them to shipping platform

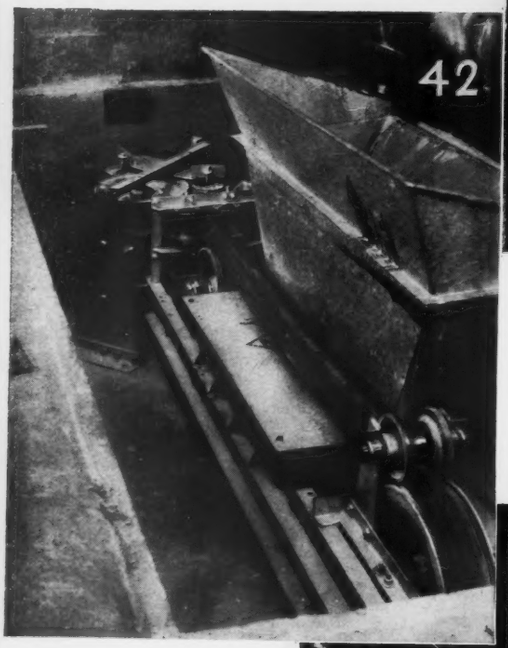
40. STEEL STRIP—three ram trucks handle coils 24 hours a day in this plant, from pickling to storage or cold roll, to scales and storage, to rotary shears

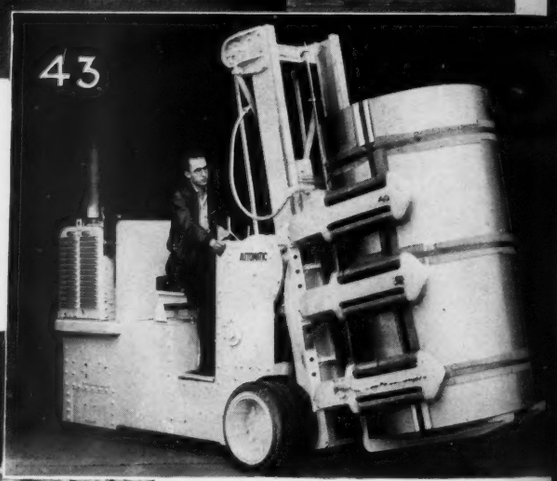
NO MATTER WHAT YOU HAVE TO HANDLE



41. STEEL SHEETS—an overhead rail system (American Engineering) with cab-controlled hoists saves $85 a day in unloading, storing, and distributing

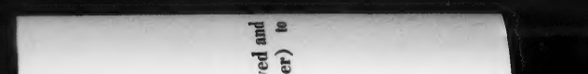
42. CHEMICALS — moving pipe line conveyor (Johns) takes chemical preparation from hopper at end of drier to packaging





43. STEEL STRIP coils weighing up to 16,000 lb. are just another handling job in the plant that has a traveling coil up-ender (Automatic)

44. FREIGHT on pallets is moved and tiered by fork trucks (Baker) to conserve space



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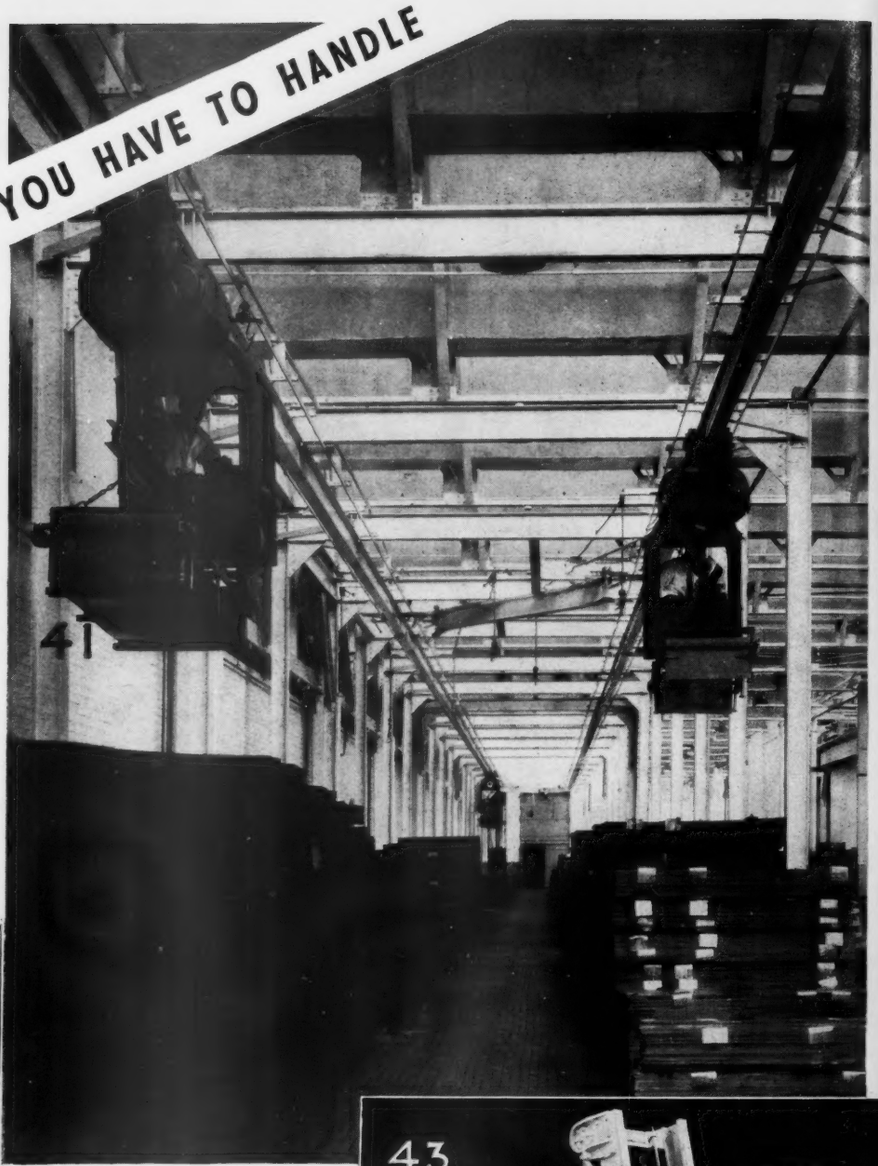

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Switchgear for a Steel Mill

Some features of construction that help to give such equipments the ruggedness, simplicity, and reliability that are required of them

G. A. VAN BRUNT
Associate Editor

PRODUCTION requirements in steel mills demand extremely reliable operation and sturdy construction of all electrical apparatus, particularly the control and protective switchgear. If the control and protective equipment fails, or requires much idle time for maintenance, the resulting interruptions to manufacturing processes are costly. Therefore strength, long life, and accessibility have to be built into switchgear designed for such service. It must also embody another important feature — compactness. From the standpoint of these requirements, there are a number of interesting features of construction in an installation of switchgear shown in Figure 1 recently built by the General Electric Company for controlling auxiliary apparatus such as blowers, fans, filters, heaters, exciter motor-generator sets, and so on, in a large steel mill.

Among these features are air circuit breakers, structural shapes such as channels and angles for the main bus and connections, and a new type of panel wiring.

The d.c. generator and feeder circuits are protected by solenoid-operated, air circuit breakers that have solid main current members with silver-to-silver contacts, which are held together under high pressure. Main contacts are protected against burning by solid, metallic intermediate and arcing contacts, giving in effect a triple-contact construction. The solenoid mechanism is built into the breaker.

Generator circuit breakers form part of the protective and automatic control equipment associated with the d.c. end of the motor-generator set. The d.c. feeder circuit breakers form part of an automatic reclosing equipment which, after opening the circuit in case of a fault, measures the resistance of the feeder circuit and permits the circuit breaker to reclose automatically only in the event that the feeder resistance exceeds a certain value, thus indicating the disappearance of the fault.

Interrupting speed during faults is very high. The tripping mechanism releases the latch directly, and with breakers applied to d.c. circuits the time of initiation of the tripping operation becomes less as the rate-of-rise of the current increases. This feature, which is termed discriminating overcurrent trip, is obtained magnetically. The entire unit is mounted on the front face of the panel where it is accessible.

Panel Wiring Is Inclosed

These characteristics of the circuit breaker materially reduce the peak current and over-all time of fault on d.c. circuits, particularly when the faults are severe.

The air circuit breakers applied to a.c. circuits utilize the same type of solid main contact members (silver-to-silver, high-pressure contacts) and arc interrupting means mentioned above. These circuit breakers are, however, of multi-pole construction with an attached solenoid mechanism. The over-current tripping mechanism is trip-free and direct-acting, but no discriminating feature is used.

Reclosing a.c. air circuit breakers operate on a different principle from that used on the d.c. breakers. A periodic reclosing cycle is utilized whereby the circuit breaker is reclosed a predetermined number of times (at prescribed intervals) regardless of whether the fault which originally tripped it remains on the circuit. In the event of successive consecutive openings, caused by a persisting fault, the circuit breaker is locked out after the last opening. Then manual resetting of the reclosing relay is required before the automatic reclosing cycle is restored and the circuit breaker is ready for further reclosing duty.

Both types of air circuit breakers are mounted on slate panels supported by channels or angles. Use of these shapes permits the space between flanges, or at the corner of the angle irons, to be used for the long runs of vertical panel wiring that pass along the vertical borders from one section of the panel to another. The panel wiring is held in place by a perforated wiring support and is formed on a templet prior to installation. A cover, held in place by the flange of the channel, or by the wiring support when angle irons are used, completes the inclosure of this wiring runway.

Many perforations are made in the side of the wiring inclosure facing the center of the panel, which provide a flexible means for bringing out and supporting the wires for the various instruments and devices at any point required. This method of panel wiring also incorporates facilities for inclosing the horizontal cross-connections between panels, thereby enabling all such connections to be carried in metallic inclosures.

Since the d.c. circuit is ungrounded, with a circuit breaker in the positive side, it was necessary to provide a disconnecting device in the negative side of the circuit. The latter device is mounted on the switching structure, and in order to simplify the copper connections it was desirable to mount both the positive and negative buses on this structure. The closeness of these buses, together with the extremely high values of current encountered during fault conditions, produce magnetic forces that are transferred to the bus supporting members; therefore these stresses had to be considered in the design of the structures.

Figure 2 shows how the bus structure is designed, each bus unit consisting of two copper channels. The lower flanges of each channel are bolted at intervals to flat plates which, in turn, are bolted to extra-

heavy-duty porcelain insulators. Upper flanges are bolted at intervals to angle-iron braces which extend between the positive and negative bus and are fastened together through similar porcelain insulators. The entire bus structure is supported by channel irons which also brace the upper portion of the switchboard, as Figure 3 shows.

Accessibility Is Increased

In addition to the compactness and strength gained by this arrangement, the various parts of the bus, primary devices, and panel-mounted equipment are more accessible.

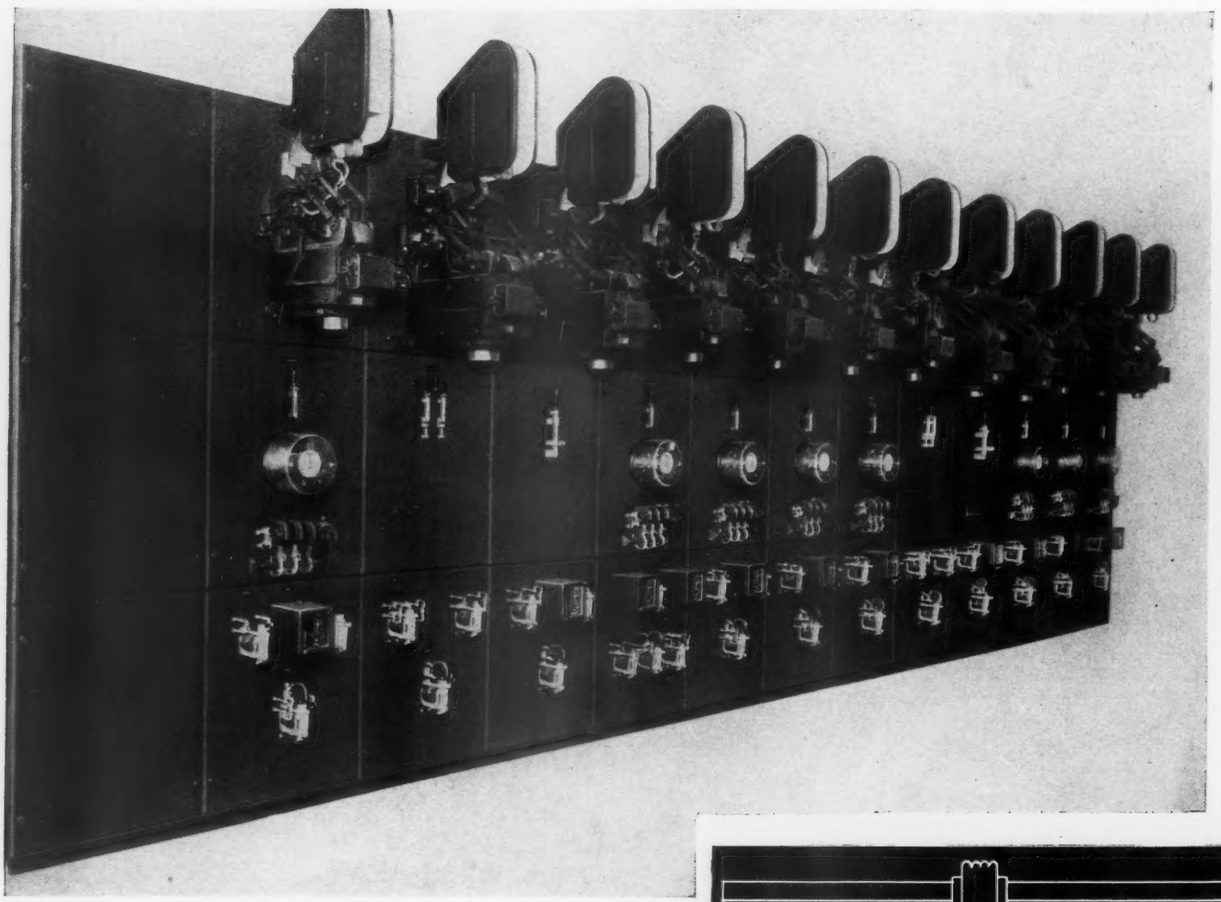
The space between the two channels forming the positive or negative bus unit not only provides means for locating and bolting connection bars from the circuit breakers and knife switches, but furnishes a space for the circulation of air, which ventilates the bus.

In Figure 3 is also shown a design of disconnecting switch which has been developed for this form of switchboard construction. This type of switch is equipped with silver-to-silver line contacts. To warn the operator against opening it under load, indicating lamps located between the switches show whether the associated circuit breaker is open or closed. Opening due to magnetic stresses caused by heavy loads or short circuits is prevented by means of blade latches. These latches are automatically released during the first movement of the switch handle.

The switch is mounted on porcelain insulators and is provided with horizontal laminations which enable flat bends to be made to the connection copper, as Figure 3 shows.

Location of the disconnecting switches as shown contributed to the simplification of the back-of-board design. It has not only resulted in simple, direct runs of copper connections, but has made the rear of the switchboard easily accessible.

In some instances a relatively long run of connection bar was required where supports could not be closely spaced. This requirement was met, as shown in the upper portion of Figure 3, by the use of connection bars which are angle-shaped in cross-section, thereby giving the desired degree of rigidity. These connections are carried on porcelain insulators over the main bus structure.



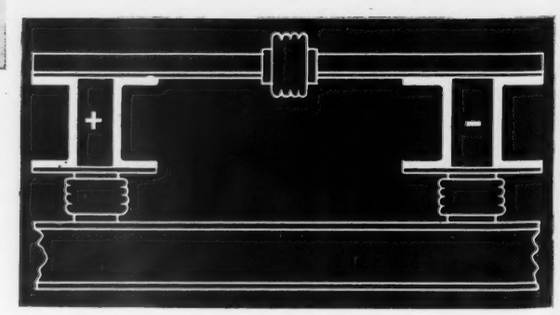


Figure 1 (above). This is a front view of the 250-volt d.c. generator and reclosing feeder switchboard

Figure 2 (right). Method of mounting and bracing the heavy-duty d.c. buses, which are made of channel-shaped sections

Sections of the d.c. bus were made by bending flat plates having a maximum length of 10 ft. each and then welding these together to form a bus of the required length. The ends of each section to be butt-welded were chamfered to the specified angle and depth and then firmly held in place on the welding plate.

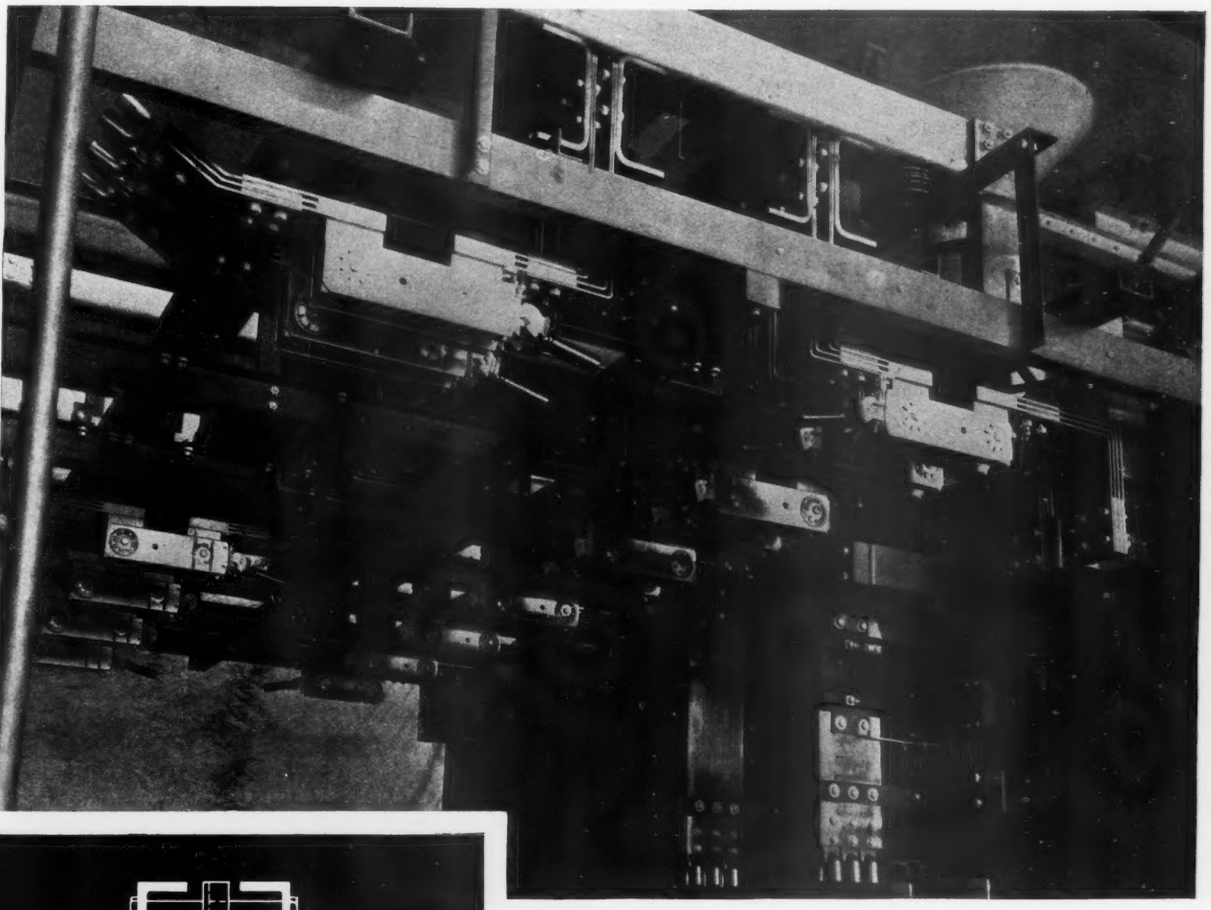
The maximum length of welded bus so far produced is approximately 35 ft. and is limited by handling facilities. It is said that the welded joint does not show any appreciable temperature rise over adjoining portions of the bus, making it superior in this respect to a bolted joint. The mean linear coefficient of expansion of copper is 0.167×10^{-4}; therefore a change in temperature of 40 deg. C. in a 35-ft. copper channel bus will produce a change in length of slightly more than $\frac{1}{4}$ in. Owing to the use of main supporting members at right angles to the bus, together with bolted joints, it has been found that the small amount of expansion encountered does not require the use of expansion joints, fittings, or other special features.

Channels Form A.C. Buses

In the low-voltage a.c. (three-phase) applications, the buses are grouped at the rear of the switchboard. The bus associated with each phase is made up of two channel sections which face each other, as shown in Figure 4. Here again the bus is mounted on porcelain insulators, following somewhat the same construction used with the d.c. bus.

The a.c. bus construction shown in Figure 4 utilizes two channels facing each other so as to approach the configuration of a tube, which has the minimum skin effect, or maximum current capacity. Space between the channels permits the center portion of this assembly to be ventilated. Channels are separated at each insulator support by spacers, through which pass bolts that are common to the two channels. The spacers bear against a vertical support which, in turn, is welded to the plate resting on the insulator.

A number of years ago manufacturers began the practice of shipping metal clad switchgear and electrical control boards in assemblies as large as transportation and handling facilities would permit. This practice has been extended to such boards as the one described.



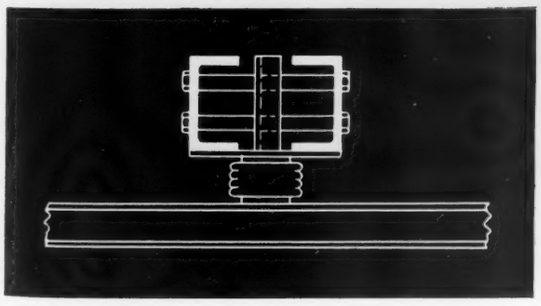


Figure 3 (above). Rear view of the reclosing feeder switchboard shown on the opposite page.

Figure 4 (left). How the channels used in each phase of the heavy-duty buses are mounted

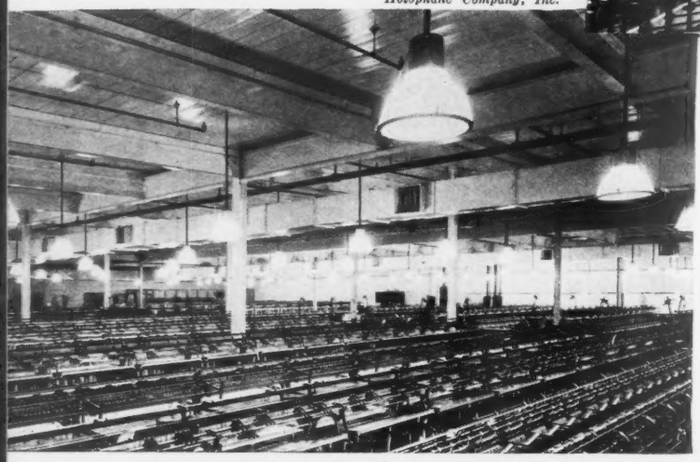
In a knitting mill a "Light-Hood" unit provides all the light needed by the operators of these thread twisters

One 500-watt lighting unit is provided for each tapping table in a silk hosiery mill. With the 200-watt lamps used when this photograph was taken, the intensity was 20 foot-candles. Units are mounted 10 ft. from the floor, on 8-ft. centers

Holophane Company, Inc.

Curtis Lighting, Inc.

They Light

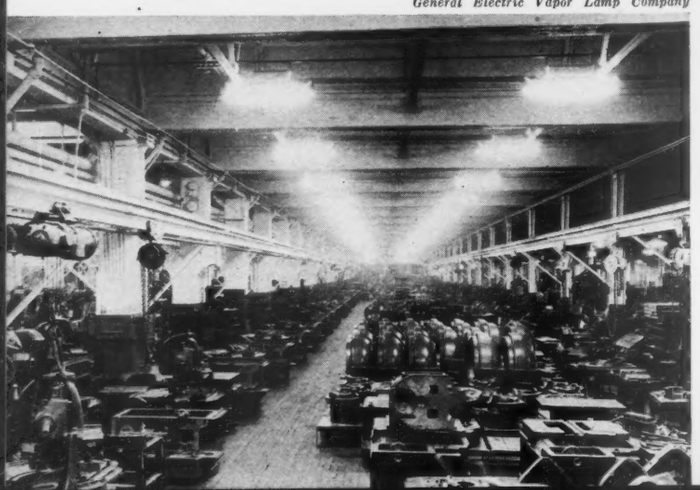


Radio sets are assembled under 80 foot-candles produced by high-intensity mercury lamps in Glassteel diffusers, alternated with 500-watt incandescent units. Mounting height is 9 ft., on 8x8-ft. spacing

Benjamin Electric Mfg. Company

A manufacturer of machine tools uses units containing a 375-watt mercury-vapor tube and four 100-watt incandescents mounted above panels of diffusing glass. Height is 16 ft., on 15x18-ft. spacing

General Electric Vapor Lamp Company



Curtis Lighting, Inc.

With 45 foot-candles of illumination, these chandelier makers can't blame poor workmanship on inadequate lighting. The lighting trough of this unit contains 200-watt incandescent lamps spaced on 30-in. centers

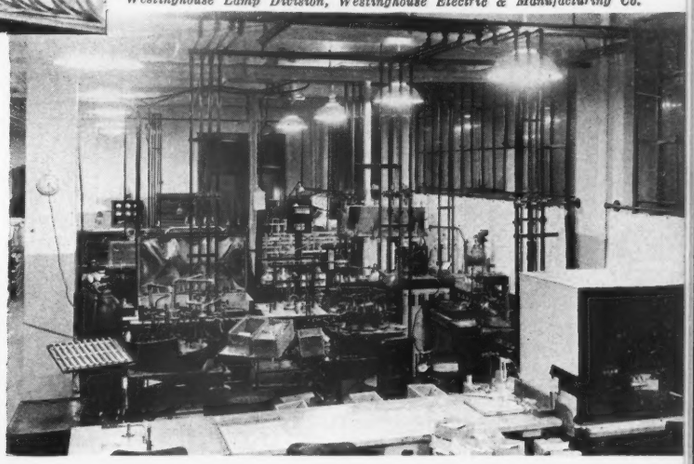
Benjamin Electric Mfg. Company

Buffers in a metal-working plant are given all the light they need to do good work by "Skylight" units with 150-watt clear incandescent lamps. Mounting height is 6 ft. 2 in. above the floor

Workers in this laboratory don't have to strain their eyes, with an average intensity of 25 foot-candles provided by 250-watt, high-intensity mercury lamps in Glassteel diffusers. Units are mounted 10 ft. above the floor, and spaced 10 ft. in each direction

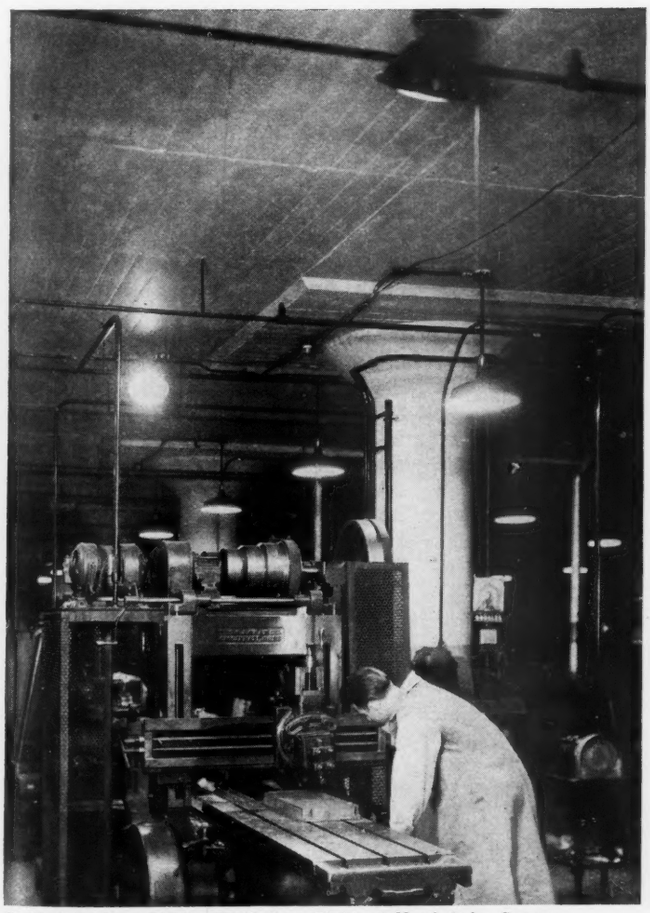
Westinghouse Lamp Division, Westinghouse Electric & Manufacturing Co.

to See



Glassteel diffusers (below) with 300-watt incandescent lamps give these candy makers 17 foot-candles

Incandescent Lamp Department, General Electric Co.

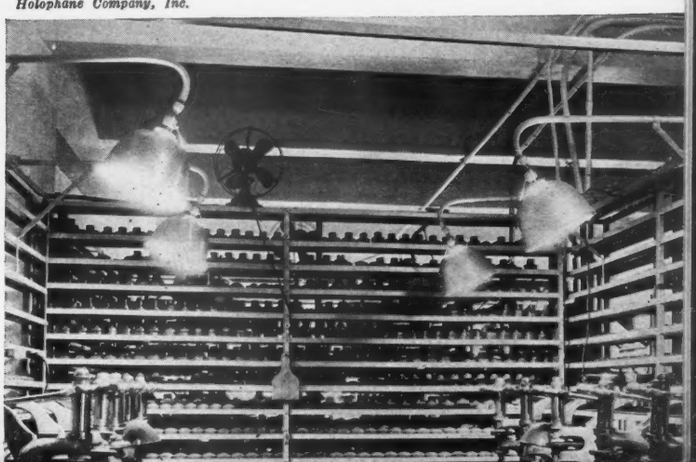


Westinghouse Lamp Division, Westinghouse Electric & Manufacturing Company

More light was needed at a particular spot, and it was not convenient to install a local unit. The trick was turned by mounting two 200-watt industrial floodlights on the ceiling

Lens grinding has to be well lighted. Here 40 foot-candles is provided by 150-watt incandescent lamps in crystal lens units, mounted so that the light falls between the head of the operator and the machine

Holophane Company, Inc.



Rigid and Flexible Drives

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LAST MONTH the methods comprising the flexible and rigid systems of power drives were discussed briefly and their general characteristics outlined. In this article the proper application of these methods will be considered two basic.

Flexible Methods

Modern Group, Employing Belting or Chain. These two methods are similar, with the exception that one employs belting from lineshaft to driven equipment, whereas the other employs chain. Whether to use belting or chain as the power-transmitting medium can be determined as follows: (1) Use chain when the speed is low and the power pull heavy. (2) Use chain, clutch controlled, when the load and speed require belting more than 8 in. wide; beyond this width belting is difficult to shift. (3) Use chain when the starting torque is more than moderately heavy because slippage on starting is destructive to all types of belting. (4) Use chain where the atmospheric conditions are severe, because it will be possible to inclose it in a dust- and fume-tight, self-lubricating housing.

The belting group method is applicable to both production shop and process plant operation for driving batteries of machines when the individual machine running load does not exceed 7 hp. Rating of prime mover should not exceed 50 hp.

The chain group method is used almost exclusively in process plant operation. Individual apparatus load should not exceed 10 hp., and the prime mover be of not more than 75-hp. rating.

Chain Direct. This method is applicable for the direct driving of line- or headshafts and various types of machines from motors operating at standard synchronous speeds from 720 to 1,800 r.p.m. For low-power requirements, such as fractional to 3 hp., motor speeds of 3,600 r.p.m. are practicable.

With this method either the Silent or the Finished Steel Roller chain is required, the choice being dependent upon speed, power, and the mechanical conditions involved. Where flexibility, positive velocity ratio, and short centers are desirable this method should be employed. Occasional shock loads, severe vibration, and the problem of positive speed differential, can be solved by using a high-speed chain connection. When the chain is of the correct size for the power and speed, and of proper ratio, the chain direct method results in longer life than any other short-center flexible method, provided there is proper lubrication and protection from abrasive materials.

V-Belt. This method is applicable to either production shop or process plant short-center driving of shafting and practically all types of industrial equipment. For driving production shop machinery it is of particular advantage where the absence of chatter is desirable. The unique locking effect developed as the V-belt seats itself in the groove of the sheave is responsible for certain advantages of this method. These advantages are: (1) Short center distance with ratios of 8 to 1, because regardless of a possible small arc of contact on the smaller sheave, excessive slip is prevented. (2) Ability to absorb shock and pulsating loads, because of a cushioning effect as the belt seats in the groove. (3) Low maintenance. (4) Low replacement cost, since renewal of belts is all that is necessary. (5) The possibility of use on medium-center drives.

A V-belt drive must have center-distance adjustment and be protected from mineral oil and grease.

In process-plant applications the factors which favor the chain direct method over the V-belt are: (1) Shorter center distance for equal ratio. (2) Possibility of fixed centers. (3) Positive driving. (4) Ratios up to 12 to 1 possible. (5) Can operate not only under severe atmospheric conditions but also in abnormal temperatures.

Pivoted Motor. This is an efficient flexible method, utilizing flat belting of practically any type on short centers. Two designs are available; the gravity type which automatically tensions the belt by the weight of the motor, and the reaction-torque type which employs a definite force inherent in all electric motors, that is at any moment equal to the force exerted on the belt by the armature. A particular attribute of both designs is automatic belt tensioning, which accommodates stretch, centrifugal tension, and load fluctuations.

This method requires no adjustment facilities and is practicable for ratios up to 7 to 1. The characteristics which assist in selection are: (1) Efficiency is maintained at peak loads. (2) It overcomes centrifugal tension. (3) Center adjustment is automatic.

Variable-Speed Units. Mechanisms of this character are almost always employed in connection with other transmission methods; therefore they are classed under the flexible system only when their internal parts are of a flexible nature. In view of this fact, selection can be based on whether, in the combination, the variable-speed unit must act as the flexible medium.

The Wearn Autoflex. This is a new driving mechanism for short-center flat or V-belt installations. It provides extremely short centers, automatic adjustment of belt tension to load, shock absorption, and high-ratio capacity. Essentially this device comprises a gear keyed to the shaft to be driven and a pinion which meshes with the gear. The pinion is driven by a belt pulley or V-belt sheave through a shaft carried in a floating housing pivoted on the driven shaft. When the pulley is revolved by the motor belt it causes the pinion to make an epicyclic movement around the gear; hence, the driven shaft starts to rotate as soon as the torque due to the belt tension balances the load resistance.

Ratios of 10 to 1 up to 20 to 1 are

TABLE I

Efficiency and First Cost of Three Flexible-Method Drives*

Drive	Efficiency Per Cent	First Cost Net
Silent chain (inc. casing)	97–98	$81.54
V-Belt (without guard)	90–96	95.90
Pivoted motor (without guard)	96–98	80.80

*Based on 25-hp., 1,800-r.p.m. motor; 3-to-1 ratio; 3-ft. 6-in. centers.

a common requirement which cannot efficiently be met with chain, pivoted motor, or V-belt; therefore it is necessary to resort to gear reduction units of the rigid system, or double reductions of the group method. The Wearn drive can provide such ratios flexibly and compactly. Table I shows the relative efficiency and first cost of three flexible-method drives.

Rigid Methods

Direct-Coupled Motor. This is "direct connection" and commonly signifies integral motor mounting with high-speed driving. The motor, of whatever type, should be flexibly coupled to the driven machine or apparatus. Selection factors for this method are that the input speed of the driven equipment must correspond with that of the motor, and consideration must be given to the starting torque. If the starting torque is high, either the motor must be of the proper type to handle it, or a special coupling must be employed between motor and load.

Worm-Gear Reduction Unit. Comprises both vertical and horizontal driving and is employed for both moderate and low output speeds. It is adaptable to almost any form of speed reduction regardless of whether the prime mover is a motor, turbine, or an internal combustion engine, since at high worm speeds these units, when properly designed, operate quietly and efficiently.

Factors governing selection of this method are, in addition to low installation and maintenance costs, low depreciation, and insurance against breakdowns: (1) High ratio possible in small space. (2) Self-correction against wear. (3) Operation at high input speeds. (4) Continuous load-bearing capacity. (5) Quietness of operation. (6) Transmission of power at right angles.

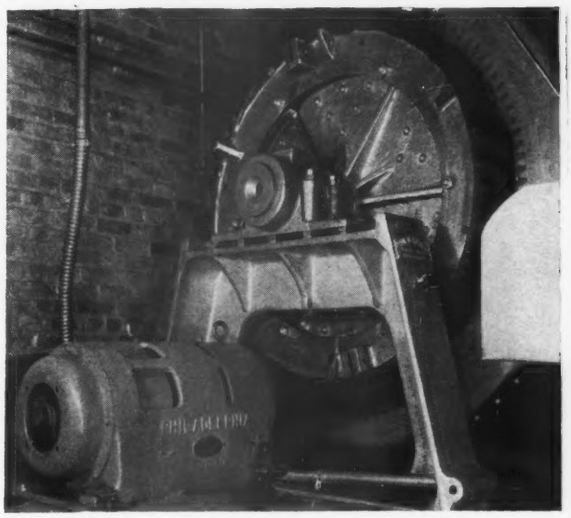
This method is adaptable to fractional-horsepower requirements as well as heavy work, such as rolling mill screwdowns. Permissible worm speeds range from 100 to 4,000 r.p.m. with ratios up to 100 to 1 for single-reduction, and 10,000 to 1 for compound units. In single-reduction gear assemblies the worm and worm gear possess higher ratio capacity than any other form of gearing. At the higher ratios, however, the efficiency is reduced.

Power rating is in direct relation to ratio and worm speed. Although much higher ratios are possible with compound units, the horsepower capacities are relatively low since the torque for a given horsepower varies inversely with the speed. In view of this fact the single reduction has a larger field in general industrial operations.

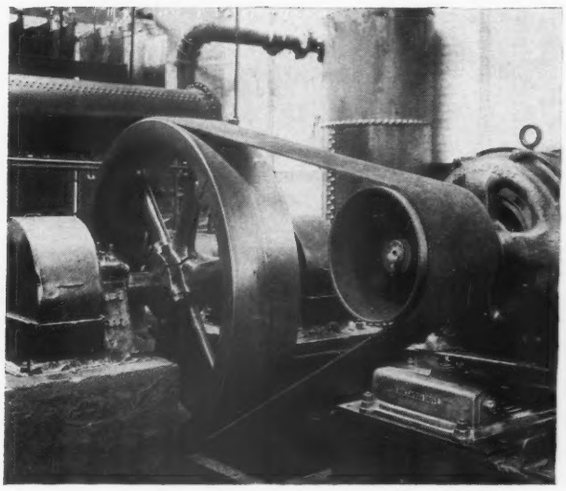
Spur Gear Reduction Unit. This method utilizes either the planetary or non-planetary gear assembly. The planetary type, which employs a fixed internal gear and orbit planet pinions, is more extensively used in view of its higher efficient ratio capacity in double and triple reduction. It is a method that is particularly suitable for the direct connection of lineshafts and for moderately powered loads where horizontal, straight-line driving is necessary.

Factors favorable to this method over the worm gear unit are: (1) Straight-line driving. (2) Higher efficiencies at high ratios. (3) Compactness for equivalent power and ratio. Right-angle driving is possible with this method, but it is costly owing to the necessity of using bevel or miter gears in conjunction with the standard gearing of the unit.

Motorized Reduction Unit. With this method motor and gear assembly are combined in one unit. These units are made with the motor supported and the gear reduction unit overhung, with the gear reduction unit sup-

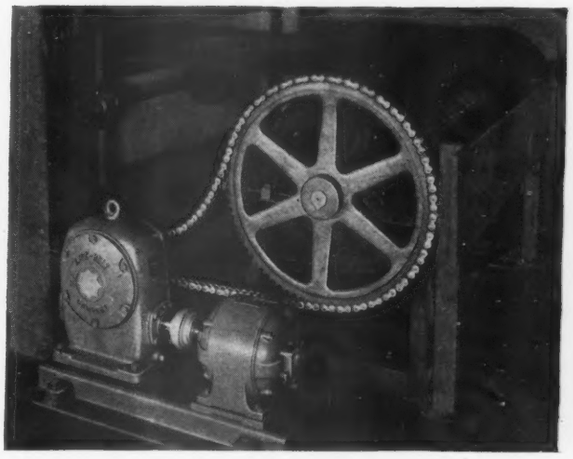


Here a motorized reduction unit is driving a horizontal mill. Absence of a baseplate, separate motor, and coupling gives a compact drive



To drive this compressor, a flexible method was chosen — in the form of a flat belt automatically tensioned by a pivoted motor base

Sometimes a combination of rigid and flexible driving methods is required — for example, a worm reduction gear and roller chain



ported while the motor is overhung, and with both motor and gear reduction unit supported. Choice of construction is a matter of opinion; all three are built substantially.

Regardless of the employment of various types of gearing, the planetary assembly and the helical gear assembly are the most popular.

Advantages of this method are: (1) Elimination of baseplate and flexible coupling. (2) Compactness, making possible high-ratio direct connection in small space. (3) Permanent alignment of motor and reducer. (4) Efficiencies equal to that of the gear assemblies employed. (5) Accessibility of motor and reducer parts. (6) Alternating-current motors of any type can be employed. (7) Ideal for both vertical and horizontal in-line driving. (8) Lower first and installation costs as compared with a separate motor and reducer, within a certain power range.

The motorized reduction unit should not be employed where: (1) It is preferable to have the motor separate from the reducer in the event of motor trouble. (2) The power requirement exceeds 75 hp. (3) The ratio requirement exceeds 180 to 1. (4) The ratio is low and the power high. (5) Shock or high-starting-torque loads are likely to be met. (6) Right-angle driving is necessary.

Herringbone Gear Reduction Unit. Available in single-, double-, or triple-reduction types, with shafts in line or offset, and maximum ratios of 10 to 1, 70 to 1, and 320 to 1, respectively. Power range for standard single- and double-reduction units is 1½ to 1,300 hp. Standard, triple-reduction units are available in ratings up to 75 hp. The double-reduction design with shafts offset is known as the tandem type, while with shafts in line it is termed the box type.

Factors which should influence the choice of this method are: (1) Continuous smooth, noiseless action of gears (two teeth always having two points of contact in the plane of axis. (2) Great strength, therefore minimum bending action of the load. (3) Elimination of backlash. (4) Large power capacity through comparatively small gears. (6) Conservation of space and low power consumption. (7) Long service, due to minimum friction and vibration.

Open Gearing. As a direct-connection and speed-reduction arrangement between motor and driven equipment this method is practically obsolete, because of its inferiority to the modern rigid and flexible methods. Its use is now almost solely confined to secondary reductions, since in this way a reduction unit of lower ratio can be employed.

Cut-tooth open gearing is extensively employed for integral mechanisms of machines and for driving heavy loads at low speeds.

Combinations of Systems

Because of the compactness of certain methods of the flexible and rigid systems and their adaptability to each other, it is frequently necessary, and possible, to combine them in an installation. The usual requirements are speed reduction coupled with speed variation, flexibility coupled with rigidity, and economy in first cost, based on the possibility of avoiding concentrating the entire velocity ratio in one unit of the installation. In industrial driving a combination of methods is not unusual, in view of the complicated demands and limited space.

In Table II are shown the efficiencies and initial costs of five rigid-method drives.

Probably the greatest problem to be contended with in modern mechanical power application by any method is the gradual acceleration of heavy-inertia loads, or what is commonly termed high starting torque. The force required to translate a body from a state of rest to one of motion depends upon two factors—the weight or mass of the body and the rate of acceleration. This law applies to bringing machinery into motion as well as to moving an object along a straight-line path. The force necessary to set a body in motion is termed accelerating force and the twist required to start and bring machinery to full rotating speed is termed accelerating or starting torque. Starting torque must be applied gradually to avoid abuse or destruction of the driving mechanism and the driven equipment.

It is economically desirable to employ standard induction motors wherever possible with across-the-line starting, thus permitting the motor to develop full speed or torque in a few seconds. Direct connection of a motor to a load, particularly where high velocity ratios are involved, necessitates using methods of the rigid system. Because of the absence of mechanical slip with such methods, the motor is required to come to full speed under the torque applied to the driven apparatus; if the torque is heavy, destructive stresses are set up in both the driving and driven equipment, unless they are relieved electrically by substituting a slipring for a squirrel-cage motor or by interposing a mechanical device between the motor and the load.

Expensive electrical methods for overcoming high starting torque can be eliminated by the use of a mechanical device known as the mechanical slipring starter. This unit can be employed as a direct-connection coupling possessing flexible qualities, or as an integral part of a pulley, sprocket, gear, or sheave. By means of slipring friction it automatically starts machinery smoothly.

This device is inherently a torque-limiting coupling; it will not transmit to the driven machine, nor impose on the motor, more than the maximum load for which it is designed. The du Pont Company now has 125 of these starters, ranging from fractional to 150 hp., in operation because it permits rating motors at the running instead of the starting load of the driven equipment, makes it possible to use standard squirrel-cage motors with across-the-line starting for accelerating heavy-inertia loads, and serves as a positive overload release.

Ability to choose the correct mechanical transmission method is valuable to the plant engineer and to his employer, since operating profit and loss depend to a considerable extent upon the choice. Profits to an industrial organization are internal as well as external; therefore so long as the importance of the mechanical link in the power chain from generation to application is disregarded by engineer and executive, it will continue to be a waster of money and power and a brake on production efficiency.

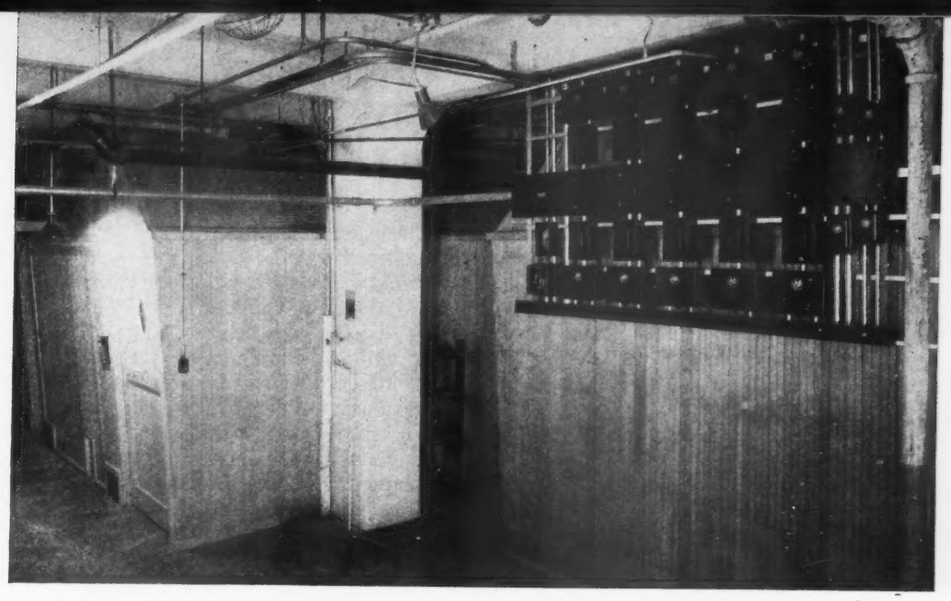
TABLE II

Efficiency and First Cost of Five Rigid-Method Drives*

Drive	Efficiency Per Cent	First Cost List
Worm reduction unit	80	$750
Spur gear reduction unit	84	425
Herringbone reduction unit	95	560
Vertical motorized unit[1]	96	1,150
Horizontal motorized unit[1]	96	1,000

*Based on 25-hp., 900-r.p.m. motor; 40-to-1 ratio.

[1]Standard, open squirrel-cage motor.



In a macaroni factory reversing switches actuated by thermostats automatically control motors driving fans in the dryers

Applying Motor Controls

G. O. WILMS

Chief Engineer, Allen-Bradley Company Milwaukee, Wis.

ONE DOES not have to be a control engineer in order to select a starter for the average line-start, squirrel-cage motor. There are, however, many applications of even such simple motors where the control engineer's experience could be put to good advantage.

In selecting controls for other types of motors specialized knowledge is even more essential. There are usually from ten to twenty standard types of starters for each type of motor, and for each of these there are many forms, inclosing cabinets, sizes, and special accessories. Although it is usually safest to secure the manufacturer's aid in selecting controls, there are certain basic facts that everyone who is concerned with control application should know in order to avoid difficulties and insure proper operation of the equipment.

The correct motor starter for any installation is determined not only by the motor, but by the load and the line characteristics as well. For almost any given type of motor one can select an automatic, semi-automatic, or hand-operated starter; an across-the-line or a reduced voltage starter; and possibly a reversing or non-reversing, single-speed or multi-speed type of starter. Which should it be?

Consider first automatic and hand-operated starters. The essential difference between the two is that with automatic starters the contacts are closed and opened by a magnet, rather than by hand. Modern, hand-operated starters will operate just as well and just as long without trouble or attention as automatic starters. But automatic control has two major advantages. First, it permits the controlling of motors from remote locations by means of push-buttons, limit switches, pressure switches, float switches, and other pilot control devices. Second, automatic control provides either no-voltage release or no-voltage protection, whereas most manual starters do not.

Protection When Voltage Fails

When automatic starters are actuated by a three-wire, momentary-contact pushbutton station, no-voltage protection is obtained. That is, if the voltage fails or drops to a very low value, the starter will open and the motor will be disconnected. However, if or when full voltage returns the motor cannot start until the Start button is pressed. Thus, there is no danger of having the motor start unexpectedly and possibly injure a worker or damage a machine.

No-voltage release is provided when a two-wire, On-Off control station, such as a vacuum switch, pressure switch, float switch, or other device of this type, is used with an automatic starter. The starter will open whenever line voltage fails, but when normal voltage is resumed the starter automatically closes and the motor starts up.

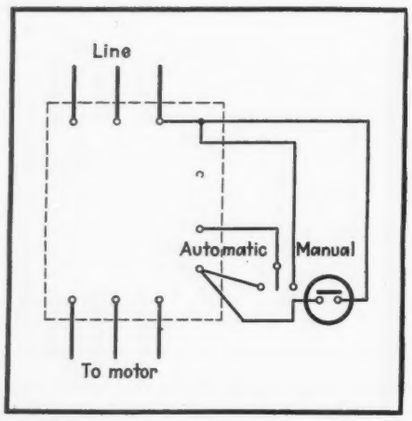
This type of control is ideal for fan and pump installations where sudden starting can do no harm, and no attendant is on hand to start the machine again if a momentary voltage interruption shuts it down.

Semi-automatic starters have a hand lever which closes the pilot contacts and actuates the main contactor. They are used with some resistance-type starters where manual starting is necessary to cut out the resistance at the proper time. These starters provide no-voltage protection just as do automatic starters.

Usually the need for remote control determines whether automatic or hand-operated starters should be used. However, if low-grade labor is to operate the equipment, automatic control is always to be preferred.

Whether a motor should be started at line voltage or reduced voltage depends upon circuit conditions and the driven machine. Across-the-line starters are simpler and less expensive than reduced-voltage starters. Therefore, they should be used whenever possible. Starting across-the-line also gives the maximum starting torque, but the inrush may be as much as six times normal current. If lights are connected to the same circuit this heavy flow of current will cause an objectionable flicker. Power companies have rigid standards covering the types and sizes of motors that can be thrown across the line at starting. Naturally, these regulations must be complied with.

Similarly, where power is gener-



Usual method of connecting selector switch so that a starter may be controlled automatically or manually

ated in the plant the capacity of the system and the size of the feeder wires determine the load that can be thrown across the line without causing an objectionable voltage dip. If full-voltage starting imposes too large a load, reduced-voltage starters must be used.

If Possible, Start on Full Voltage

The machine or equipment which the motor is driving must also be considered in choosing between full-voltage and reduced-voltage starting. In some applications where the static friction is high, only full voltage will produce sufficient torque to start the load. This is particularly true where starting is infrequent and loads are closely motored for greater efficiency—for example, a paper jordan, which may run continuously all through the week but has to be started up on Monday mornings.

On the other hand, some machines cannot stand the jar and jolt which inevitably result from across-the-line starting. For example, textile machines must be started gradually and slowly or threads will be broken. Again, sudden starting of some machines may cause serious belt slippage, or other undesirable effects.

Generally speaking, however, if the load will stand the sudden start and the line has adequate capacity, specify an across-the-line motor starter. As to the choice between reversing or non-reversing, single or multi-speed, the character of the load and the machine are usually the determining factors.

The Underwriters' Laboratories require that an across-the-line starter be capable of interrupting six times full-load current of the maximum horsepower rating of the starter, at maximum rated voltage. Nearly all modern across-the-line starters have a higher interrupting capacity than this, giving a definite factor of safety. The horsepower ratings established by the control manufacturers, however, should be adhered to.

When the Operator Won't Learn

Where operating conditions are severe or operation is frequent it is advisable to use over-sized equipment, particularly if the horsepower rating of the motor is equal to the maximum rating of the starter. On the other hand, since greater masses have to be moved the mechanical life of a contactor is reduced as its size increases. In some instances it may be advisable to select the smaller equipment, accept the shorter contact life, and renew the contacts when they wear out. In situations of this kind it is best to consult with the control manufacturer's engineers.

There is relatively little choice in selecting the pilot control for automatic motor starters. It is usually determined by the type of machine and the cycle of operation. Standard automatic motor starters can be actuated by three-wire pushbuttons, or by such automatic, two-wire, On-Off devices as the vacuum switch. or pressure, float, limit, and safety switch.

When a starter is automatically actuated, occasional hand operation may be advantageous. Or, it may be desirable to drive a compressor or a pump continuously when it would normally be controlled by a two-wire, pilot control station. By inserting a three-way selector switch in the circuit the starter can be automatically actuated, completely shut down, or actuated by hand. Such a switch can be incorporated in the starter or in a separate control station.

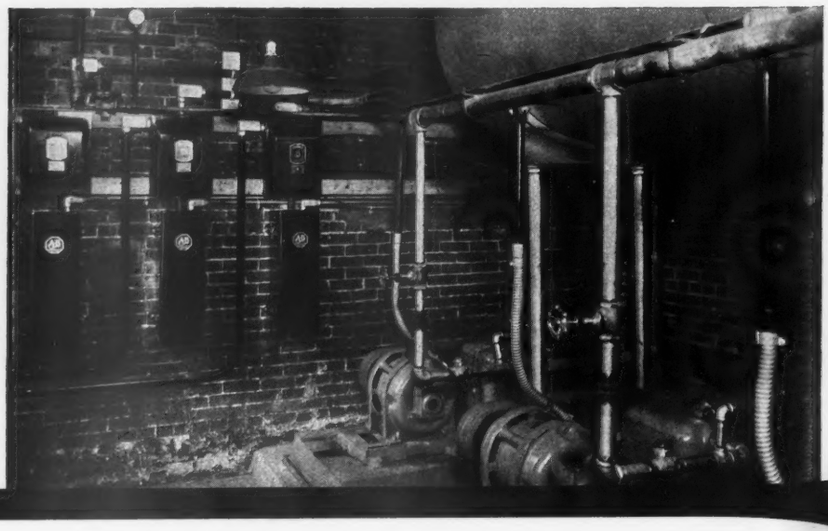
In some applications a motor starter with built-in Start-Stop pushbuttons should be selected.

The type of labor employed to operate the equipment may necessitate making the operation foolproof. For example, with an automatic starter, multi-speed squirrel-cage motors can be started on either high or low speed by pressing either the Fast or Slow pushbutton respectively. But starting on high speed causes a large inrush of starting current. With high-inertia loads it may also put undue stress on the motor and the driven machine.

If the operator will not, or cannot, learn to start at low speed and then switch to high, it may be desirable to equip the starter with a "compelling slow-speed interlock," so that nothing will happen when the high-speed button is pressed. Or, automatic-sequence acceleration can be provided so that no matter which button is pressed the motor will always start at slow speed.

The same situation is encountered in slowing down multi-speed squirrel-cage motors by switching from high to low speed. With high-inertia loads, the stress imposed when making a quick changeover may be great enough to burn belts, break gear teeth, or damage the blades of fans or blowers. To avoid these mishaps the operator must give the motor sufficient time to slow down by first pushing the Stop button, and then waiting a moment before pushing the Slow button. If he will not do this, the starter must be equipped with "automatic-sequence deceleration," which automatically interposes a delay in switching from high to low speed.

(A succeeding article will appear in an early issue.—ED.)



These 15-hp., 220-volt, three-phase, 60-cycle motors installed in a brewery are automatically controlled and drive pumps that supply filtered water at a pressure of not less than 40 nor more than 50 lb. per sq. in.

Here's to Better Lubrication

You can't get rid of friction, but it is easy to reduce bearing wear by making oil surfaces, instead of metal, rub together

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Consulting Lubrication Engineer
New York

A PRECEDING article, in the April issue, pointed out some of the erroneous ideas about lubrication that lead to bad practices and unnecessary trouble.

Lubrication does not involve elimination of friction, although that claim is sometimes made. It does not consist in the reduction of any kind of friction. Rather, it involves the substitution of one type of friction for another. That is, it seeks to substitute oil friction for metal-to-metal friction.

In its best practice lubrication becomes a matter of choosing the least of a variety of evils. More than half of the battle is won by the elimination of conditions which lead to excessive friction and destruction of bearings. This objective is accomplished when any lubricant is used which separates rubbing surfaces.

Therefore, except on ball or roller bearings, any lubricant is infinitely superior to no lubricant. A practical corollary is: When in doubt, under emergency conditions, the safest way to guard against intolerable damage is to use the thicker oil.

On the other hand, makeshifts are never satisfactory over a long period. No competitive enterprise can hope to be profitable without a high regard for economy. Unnecessarily viscous oils are not economical and their use constitutes not the least of all evils, but merely rejection of the worst. In any properly designed high-speed bearing, the more viscous oil will entail the greater friction losses. Justification for the use of lubricants other than those of lowest viscosity lies in the relationship of viscosity to film strength.

So-called "perfect lubrication" of a circular shaft consists in forming an unbroken oil casing around the shaft; at the same time an unbroken oil lining must be provided for the bearing which supports the shaft. As a result the rubbing surfaces are no longer metal against metal. In non-scientific language, the contact becomes one of oil to oil and the friction is that resulting from the rubbing of two oil surfaces. The power thus lost is dependant on the viscosity of the oil *under the conditions of use.* It is therefore obvious that viscosity, an index of such friction, must be as low as permissible.

Viscosity and Film Strength

Maintenance of these two oil surfaces or films, however, imposes a limit to decreasing viscosity. Although it is not the sole factor in film strength, viscosity is always a vital factor. For oils of the same type, I know of no instance where the more viscous of two oils will fail to form the stronger film, at a given speed, and more strongly resist forces exerted by journal and bearing which tend to disrupt this film. Hence, the heavier the duty on a machine the greater must be film strength, probably viscosity.

In addition to viscosity, speed is another very important factor in film strength. The greater the speed, the stronger the film. Roughly speaking, the two factors of speed and viscosity are of equal importance, film strength being roughly proportional to each. For a fixed bearing pressure and a given bearing, increasing the speed will give the same approximate effect as will a proportionate increase in viscosity. Doubling either or their product will permit doubling bearing pressure.

The practical conclusion is that for a bearing of fixed speed and load characteristics an oil of not less than a certain minimum viscosity is necessary to maintain lubrication. This viscosity plus some margin of safety is that which marks the lower limit of friction. The desirability of using an oil which provides this minimum is obvious.

Viscosity is not only the most important property of a lubricant, but it is the most difficult to specify correctly. As with most lubricant requirements, viscosity specifications must be determined largely by use; however, it is highly desirable that they be determined.

Briefly, viscosity is a means of

When doubtful in an emergency, use the thicker oil

expressing the magnitude of a liquid's resistance to flow. For example, if in a given bearing the viscosity of the lubricant is doubled, it is reasonable to expect that the force required to shear this oil will be doubled. Any notable exception can be safetly attributed to factors other than the direct influence of viscosity. As a consequence, with fast-moving or light-duty machinery oil viscosity may exert a tremendous, direct influence on power consumption.

In the form, such as Saybolt Universal, in which they are commonly expressed in specifications, viscosities are not directly related to true viscosity. For general use, however, their ratios may be considered as roughly approximate to the corresponding ratios of power lost as "oil" friction—the only friction occurring in "perfect lubrication." Since viscosity may be expressed at 100 deg. F., 130 deg. F., 210 deg. F., or occasionally at some other temperature, care should be taken to see that viscosities at similar temperatures are compared.

From the nature of viscosity as indicated above, it is evident that so far as oil friction is concerned, the least viscous oil is the most economical. It was also pointed out in the preceding article that low viscosity is highly desirable in facilitating the entrance of a lubricant to the point of use. In view of these two highly important facts, the lubrication problem of fast-moving machinery, say, 300 r.p.m. or more, comes down to the question: What is the least viscous oil which can be kept between bearing surfaces?

Theoretically, the answer may be derived by substituting in the proper mathematical formulas the constants of the machine and the oil. Actually, the difficulty of determining these constants is so great that the formulas are of limited industrial utility; therefore, if the best in lubrication is to be had, the only resort is to trial and error.

Trial and error, scientifically applied, consists mainly of keeping and interpreting records. Such records will be of some complexity. They should include for each type of bearing sufficient data to determine:

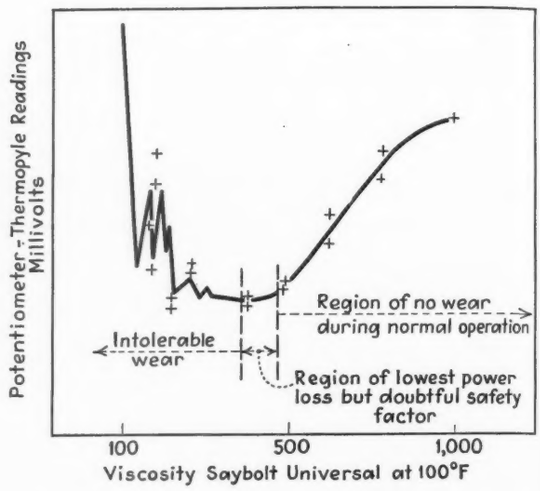
1. Total hours the bearings were in service prior to replacement.

2. Reason for replacement, such as "normal" wear, scoring, seizure.

3. Number of times the machine was started during the bearing life.

4. Viscosity of oil used.

5. Viscosity index of oil.



Typical temperature curve obtained when a bearing is lubricated with oils of different viscosity. Any convenient temperature, say 130 or 210 deg. F., may be used as the basis for expressing viscosity. It is preferable that this temperature be low enough so that the viscosity will not be less than 60 SU or more than 1,000 SU

6. Room temperature each time machine was started.

It is well to have a few recordings of the approximate temperatures of bearings after two or three hours' operation. Also, it is advisable to secure the manufacturer's specifications on the lubricant.

In its simplest form, involving but little expense, the procedure will begin by starting the above records on new bearings as they are installed and put in service with the lubricant normally employed. Frequently it is possible to collect fairly satisfactory data on bearings already in service. The reliability of such material is, of course, a matter for the judgment of the investigator.

Try Oil of Lower Viscosity

Assume that by suitable means fairly reliable information has been assembled at least for items 1, 2, 3, and 4, and that nothing striking is revealed concerning wear of bearings. The first, true experimental step is to substitute a new oil which is about 25 per cent lower in viscosity than the original, but otherwise of the same general type, preferably of the same brand.

If, after a suitable length of time, the life of the bearings using the new oil is shown to be not less than the average life with the oil previously used, distinct progress has been made. It is reasonably safe to believe that friction losses have been notably reduced, and immediate advantage may be taken of this fact by using the new oil in all bearings of the type in question. The test bearings may then be put in service with an oil of still lower viscosity. So long as the life of the bearings that are being tested shows no perceptible decrease, this procedure may be continued.

There is one point which may not be evident, but is of extreme importance: After an oil has been proved by use in the test bearings, and its use extended to all bearings of that type, good records should be kept for a reasonable number of cases. Final proof of any oil is not its performance once or twice, but its average performance in a great many applications.

Eventually this method of trial and error may be expected to lead to bearing life which is less than normal. If this happens only with a single bearing, the test should be repeated, since purely extraneous causes may be responsible. If the previous results are confirmed, it may be presumed that the lower limit of viscosity has been reached.

How far above this limit it is necessary to go for safety in emergencies is a matter of engineering judgment.

The procedure described above amounts to determining in a practical way which oils give good results and which oils fail. It, or its equivalent, is the only way in which judgment may be passed on an oil.

Regrettably it takes time which, even with increased expense, can only be shortened to a matter of months. Of the many proposed short cuts, only one seems worthy of mention:

Friction manifests itself as heat and, other things being equal, temperature is a reliable qualitative indicator of relative power losses. Therefore, a test bearing may be equipped with a thermocouple, the hot junction being protected from heat losses due to drafts. At the same time care must be taken to avoid any insulation effects which might result in appreciably retarding the dissipation of heat.

(Continued on page 152)

When Wiring Your Plant

It pays to be liberal when selecting feeder conductor size, because voltage drop, energy losses, and reserve capacity depend thereon

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SEVERAL of the important factors that influence the design of an industrial distribution system were discussed in the preceding article, in the June issue. Among these factors are the length of the branch circuits and the size of conductors.

Figure 1 illustrates how important it is to select feeder conductors from the standpoint of minimizing losses and obtaining proper regulation. Unfortunately, the figures in the Code are too frequently used for determining the actual size of cables or other conductors. Since the Code is concerned primarily with safety, it does not take into account the *distance* over which the energy is carried.

Ample Conductors Cut Losses

The curves in Figure 1 represent three sizes of cable—namely, No. 4/0, A.W.G., 300,000 circ.mil, and 600,000 circ.mil, each carrying 50 kw. of load a distance of 1,500 ft. at 220 volts. Energy cost is assumed to be 2 cents a kilowatt-hour. Losses are 15, 10 and 5 per cent, respectively, for these sizes of conductors. In four years these losses will amount to about $1,500, $1,000, and $500, respectively. Curve *W* shows that by spending approximately $300 additional over the cost of a No. 4/0 conductor for a 300,000-circ.mil conductor, a saving of $500 in losses is obtained, to say nothing of the improvement in regulation.

Likewise, if approximately $1,000 more than the cost of a No. 4/0 cable is spent initially for a 600,000-circ.mil conductor, $1,000 will be saved in four years. Better regulation and operation will be obtained, and after the four years are over these extremely important advantages will cost nothing.

The main point here is that it is necessary to investigate the conductor size for each load involved with due regard to the cost of power at the point of delivery.

It should be remembered that in Figure 1 the cost of 2 cents a kilowatt-hour was assumed merely as an example. When making layouts, determine what energy actually costs at the point of use at the motors or other devices, since it may readily be greater or less than the figure that has just been mentioned.

Do not forget that the energy cost to be considered is the cost at the meter plus other charges inside the plant, such as operation, maintenance, engineering, and overhead. Other items often found in rate schedules are: Equipment charges, power factor penalties and premiums, fuel cost adjustments, off-peak and on-peak adjustments, seasonal adjustment, and so on.

The power supply system at the transformer or power house should be laid out so that the voltage is somewhat above the standard rating of the equipment to be supplied or operated. For example, a 550-volt system will ordinarily have 575 or more volts at the switchboard, and a 220-volt system, about 240 volts. This is good operating practice because by thus supplying the voltage drop in the feeder system it insures delivery of power at the point of use without a drop in voltage below the rating of the equipment. Hence, the fifth rule: The voltage delivered at all equipment should always be equal to or slightly greater than the voltage rating for that equipment.

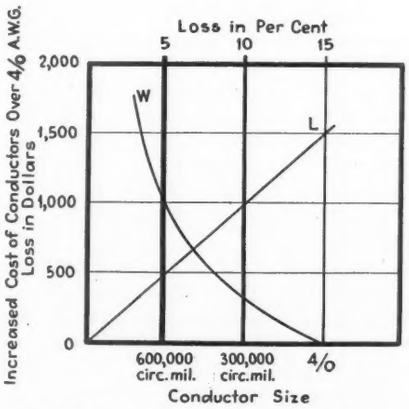

Figure 1. Energy losses, and their cost, for three sizes of conductors operated under identical conditions

Motors will operate, of course, at less than rated voltage, but they will perform better at full voltage. Usually the efficiency of electrical devices decreases and the losses increase rapidly as the voltage falls below its rated value. With motors, the power factor and torque (see Figure 2) decrease, the motors run warmer and, in some instances, at lower speed than intended. The same principle applies to heating and welding circuits and, of course, to all lighting circuits.

For Future Growth

Figure 3 shows the relative distances in feet that various sizes of wire will carry the current permitted by the Code at 2½ and 5 per cent voltage drop. No. 14 wire, for example, will run only about 35 ft. with 2½ per cent drop and about 70 ft. with 5 per cent drop at 110 volts. All of the permissible lengths shown, even for the 500,000-circ.mil conductor (about 175 ft.) are much shorter than the usual length of circuit runs. So the sixth rule is: Determine first the permissible voltage drop in circuits from the point of supply to the load; apportion the permissible drop in each portion of that circuit, such as main and branch feeders; then select the wire or cable size according to the permissible drop for the section under consideration.

About 5 per cent drop, or 11 volts on a 220-volt circuit, is often as much as can be allowed for motor circuits. With lighting circuits, 2½ per cent drop is about the maximum because any greater reduction in voltage will so decrease the amount of light obtained from lamps that money will be wasted unnecessarily for heating up the wires instead of producing light where it is needed. Few industrial plants have too much light.

It is common experience that the

electrical load always grows; that more and larger motors and other electrical devices are continually being added in a factory in order to keep up with progress in production methods and the growth in business. It is important, therefore, when selecting conductor sizes for feeders to provide a certain amount of capacity in amperes over and above present loads for future increases, unless it can be determined now that on certain branch circuits such future increases never will be necessary. In the meantime, a conductor size larger than is immediately necessary is earning money in the form of reduced losses and better supply to the motors.

More Power at 600 Volts

The question of how much additional capacity should be provided over present needs must be carefully considered. It is easier to find an answer in a specific case than to set down a definite rule. Sufficient reserve cable capacity should always be provided to make it unnecessary within a few years to disturb and rehash a good system every time a motor or two are added.

It is not advisable, however, to provide too much capacity for the remote future because future loads cannot be predicted with high accuracy. Furthermore, when a new, heavy load is connected, requiring an increase in capacity, it will be possible to have the benefit of new cable, perhaps of even better quality than present types. It should be understood, of course, that it is necessary to provide adequate wiring space, such as conduit, sufficient for any reasonable future activity over a period considerably beyond that contemplated in a load survey. This is not a difficult planning job.

When selecting the voltage keep in mind the total cost of the installation, including the cost of fuses and circuit breakers, switches, conduits, wires and cables, and their energy losses.

The most common circuit voltages for motors are 208, 220, 440, and 550, three-phase. Many plants use 2,300 and 6,900 volts, three-phase, directly. The advantage of these higher voltages lies in reducing transformer and feeder losses and making it possible to carry comparatively small feeders a considerable distance with very small voltage drop.

In industry 550 volts, three-phase, is widely used. It has the advantage of being the highest voltage for which the 600-volt class of insulation on wire and cable can be used. This class is the first step in power cable insulation. Therefore, in comparison with lower voltages, the maximum horsepower can be distributed at 600 volts, for any given size of conductor. As a result, there is a saving in conduit, fuses, and other items. Maintenance troubles probably are no greater than for lower voltages, oftentimes less.

The same statements apply to 440-volt systems, to a somewhat lesser extent. Probably 220-volt systems are the most efficient in smaller plants where runs are shorter and heavy currents are not involved. Any of these voltages, of course, can be used in any location. If power is purchased some advantages are gained by using a distribution voltage common to the community. The local power company should be consulted before a final decision is made.

In the event of a plant extension where the distribution voltage is already established, use of the same voltage in the extension offers the advantages of simplicity, convenience, easier maintenance, and so on. It is advisable, however, to make a careful study to determine whether some other voltage is better. Sometimes use of another voltage is entirely justified, as when the extension is fairly large, or it is supplied directly from a transformer bank and has its own separate feeders. Do not forget, however, that two distribution voltages require spare motors and heating devices in two ratings that cannot be interchanged.

Full directions on how to determine conductor size cannot be given here, but the following will serve as a reminder of the points to keep in mind.

Temperature Limits Capacity

The seventh rule is: Figures given in the National Electrical Code for sizes of conduits and conductors are the minimum, for safety only. From the viewpoint of economy and satisfactory operation, due consideration must be given to voltage regulation, relative cost of energy losses, and reasonable reserve capacity for future growth.

When the feeder voltage at the supply and the voltage required at the end of the circuit have been determined the permissible voltage drop over the entire length of the feeder will be known. The load on the feeder is determined in one of several ways, depending on how the distribution system is being laid

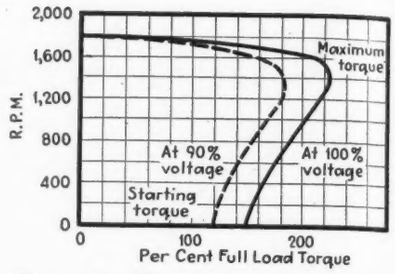

Figure 2. How a drop in voltage affects the performance of general-purpose, squirrel-cage motors

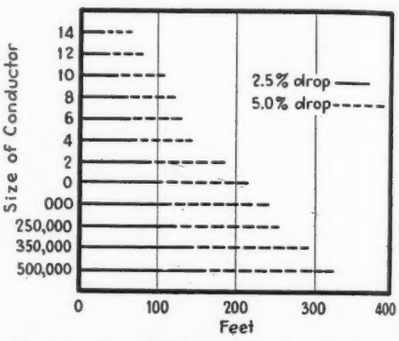

Figure 3. Distance that current permitted by the Code, at 110 volts, can be carried with 2½ and 5 per cent voltage drop

out. That is, either calculate the maximum load that may be handled in that portion of the plant served by this feeder, or total up all the connected loads and apply a diversity factor suitable to the type of load and the conditions. Then obtain by the usual method the load in amperes on the feeder, to which should be added whatever amount it is considered desirable to allow for future growth.

An easy way to determine conductor size is to refer to a table in some good handbook which shows various conductor sizes with the voltage drop per unit length for different ampere loads and spacing of conductors. Of course, the size can be calculated by the cut-and-try method, assuming a conductor size and calculating the allowable resistance and reactance (resistance only for d.c. systems).

This procedure will give the proper conductor size on the basis of voltage drop, but there are other factors to consider, such as temperature. Remember that the permissible current in a conductor is determined by its maximum permissible temperature, which in turn depends principally on three factors: (1) Maximum permissible temperature of the insulation.

(*Continued on page* 146)

Safety Instructions for Employees

(Sheets 5 and 6 in a series of 6)

MACHINE TOOLS

1. *Emery Wheels*

a. Emery wheels must be kept true, with guards and eye shields in good condition. Work rests must always be set close to the wheel to prevent the piece being ground from getting caught between the wheel and rest. Goggles must always be worn by the operator.

b. Only authorized persons shall dress emery wheels, and then only with standard dressing tools.

c. Grindstones shall be dressed preferably with the standard grindstone dresser.

d. Endless belts are to be used wherever possible. Do not grab belts to stop machines, however, because they may contain lacings.

2. *Putting on Belts, etc.*—Only experienced and careful men whose job it is shall put on belts or ropes, oil shafting, overhead pulleys, and machinery. In doing this work all safety rules must be observed and standard devices used. Running belts must not be touched with the hand. Belt dressing must be applied only where belt is running away from pulley.

3. *Clearing*—A brush or pick should always be used for clearing away chips, borings, or dust. The hands must not be used for this purpose.

4. *Lathes*

a. Where possible, a lathe chuck with jaws extending beyond the outside diameter of the chuck should not be used. Jaws should be reversed or a larger machine used. Operators are also warned against being struck by overhanging parts of the work.

b. When placing extremely heavy work in a lathe, centers that are strong enough must be used and stock blocked up as near to centers as possible to support material in case of failure.

c. Drill must not be held in lathe with a dog.

d. Large stock in a lathe chuck must not be faced off without supporting it from tail stock center.

e. Only safety lathe dogs, with concealed setscrews must be used.

f. Crankshafts or other irregular pieces with extending parts should not be polished with emery cloth in hand. A block of wood fastened in the tool post should be used.

g. Tail stock spindle should never be used for drill socket.

5. *Chip Guards*—On lathes and other cutting machines, chip guards must be used when machining brass, babbitt, or any other material from which chips are apt to fly. Where chip guards cannot be used, operator must wear goggles.

6. *Drill Presses*

a. All work to be drilled must be clamped to the drill press table or held in approved holding devices. Anything being drilled must never be held by hand.

b. Operator should be careful in using twist drills on light stock.

c. Broken taps shall be removed by a tap extractor.

d. Never feel under a piece of work to find out whether drills, reamers, etc. are coming through.

7. *Planers*

a. Belt shifters on planers and shapers must be securely locked or fastened before handling work on table.

b. Work must be securely fastened on bed before starting planer, shaper, milling machine, etc.

c. Planer table must never be turned by hand except where necessary in setting up work.

d. Operators are warned against being caught between the work and the machine housings.

e. Shaper tools must never be adjusted while machine is in motion.

f. A clearance of not less than 24 in. at both ends and sides of planers must be maintained at all times. This includes the work being machined and its chucking. If for any reason the clearance has to be less than 24 inches, then the space must be guarded by standard railing.

8. Always withdraw milling machine table far enough when removing work to prevent hands and clothing from coming in contact with cutter.

9. *Squaring Shears*

a. Shearman working with helper or helpers shall always be very careful to see that fellow workman is out of danger before stepping on clutch bar. Never do repairs or adjustments while shears are in motion.

b. While shearing material for shop, never pile cold rolled, pickled and oiled steel into straps. Do not pile cold roll or pickled and oiled material, bunching up short and long pieces into one shell. *Balance your load!*

PRESS DEPARTMENT

1. *Washer Presses*

a. Tools must be in good shape and all punch pushers (slug knockouts) must carry proper length and be kept in good order.

b. While setting up tools or dies never put fingers or hand between punch ram and die block to catch or pick up sample while press is in motion. On open belt and friction clutch drive presses, make sure that press cannot start up while setting tools. If pulleys or belts are out of order, report to proper authority at once.

c. Never try to grab in between stripper or punches or between feed rolls or any moving or revolving parts while press is in motion.

d. While piling skeleton scrap into shells at washer presses, always try to pile scrap evenly. If it is not piled properly it will slip or spill badly.

e. On horizontal presses, always remove ejector while disposing of job or articles made through read of die.

2. *Stamping Presses*

a. Tool and die setters must be sure to keep clutch pins locked on belt-driven presses while setting up dies. Be sure to pull disconnecting switches on all presses while setting up dies. Never try to turn crankshaft with bar while flywheel is in motion. Use safety bars on crankshaft. Be sure that you and your fellow workers are safe.

b. Tool and die setters must always be sure that dies taken from one press to another have proper clearance for disposing of slugs and other articles. Knockouts or plunger pins must be adjusted to proper length when taken from one press to another. Keep your tools in good working order.

ELECTRIC CRANEMEN

1. *Operation*—No one but a regularly authorized person is allowed to run any crane.

2. *Idle Equipment*—When locomotive, jib, or electric traveling cranes are idle, the hanging equipment must be brought to rest on the ground or a platform built for that purpose, and not allowed to stay in the air. The hook must be raised clear of floor.

3. *Controllers*—Before opening or closing main switch, the operator must make sure that all controllers are in "off" position.

Prepared by EUGENE CALDWELL, General Manager, Wrought Washer Mfg. Co., Milwaukee

4. *Seeing Conditions*—Cranes must not be operated if cranemen cannot see well because of fog, smoke, dust, etc.

5. *Switches*

a. Limit switches must not be abused; they are intended as a safety device and should be tested daily, but not used for a cut-out on each lift.

b. Never go on top of crane or let anyone else do so without tagging the main line switch in the crane cage in the open position. The tag is to be removed only by the person placing it. When leaving cage, open main switch.

6. *Load*

a. In racking carriage or moving crane bridge, great care must be used that load is high enough to clear everything in its way.

b. When handling heavy loads, test hoist brake by throwing controller to "off" position after load has been lifted a few inches; if brake does not hold load, do not move crane until it has been repaired or adjusted.

c. Do not carry objects up and down ladder; use rope or handling anything too large to get into pockets or belt.

d. Loads carried by moving crawler type crane must be securely hooked and the boom trailed.

7. *Defects*—Examine your crane at beginning of turn for loose or defective runways, railings, warning bells, signs, switches, railsweeps, cables, etc., and report any defects found. See that crane is clean and well oiled, and that fire extinguishers are filled and in good condition.

8. *Cleanliness*—Cranemen must keep crane cage clean and free from all inflammable and unnecessary material.

9. *Repairs*

a. When crane is down for repairs, operator should help repairmen, unless otherwise ordered. After job is completed, make sure that bolts, tools, etc. have been removed so that no damage will result when crane is started, and so that nothing can fall off crane. Keep tools, oil cans, and other loose objects in box provided for that purpose.

b. When repairs are being made on cranes, bridge and trolley should be stopped over a balcony whenever it is possible to do so.

10. *Signals*

a. Operators of cranes must not swing into any car, or into any place into which he cannot see, unless he receives proper signal to do so.

b. Standard crane signals must be used and cranemen must take signals from only one man who must be the hooker or someone told to do so by the hooker.

11. *Warning Gongs* — Sound warning gong when carrying loads in the vicinity of employees at work.

• Topics for Safety Meetings •

1. HANDLING MATERIALS

Many accidents occur to workers when handling materials by hand or by hand trucks. In fact, in the average plant, more workers are injured when handling materials than when working on the machinery. Thus, anything that will eliminate the hazards of handling materials should reduce considerably the accident records of the plant as a whole.

In general, such accidents can be prevented by:

(1) Formulating shop rules, making them known and thoroughly understandable to the workers, and then by enforcing them.

(2) Improving condition of plant and equipment.

The Safety Committee will want to discuss the subject of handling materials in detail. It then may seem advisable to appoint one or more subcommittees to make a survey of certain departments or of the entire plant. Instruct each sub-committee to look for things that may cause materials handling accidents. In making a survey and in preparing their reports, the subcommittee members should answer such questions as:

(1) Are bolts and nuts tight on trucks so loads will not shift?

(2) Are truck wheels in good condition so they will not come off?

(3) Are suitable trucks provided for the loads to be carried?

(4) Are trucks equipped with brakes or is blocking material provided so trucks will not move unexpectedly when being loaded or unloaded?

(5) Are brakes in good condition?

(6) Is steering mechanism in good condition?

(7) Are trucks properly loaded so load will not fall and so men can push them safely?

(8) If trailers are used, are couplers of proper design and in safe condition?

(9) Are floors level and in good repair for safe trucking and carrying materials?

(10) Does poor illumination increase any existing hazards?

(11) Are knuckle guards provided on truck handles where possible?

(12) Are aisles of sufficient width to permit safe operation of trucks?

(13) Are piles of materials and storerooms so arranged that materials can be handled safely?

(14) Are piles of material cross-tied where necessary to prevent their falling?

(15) Are tote boxes, trays, barrels, and other containers of suitable size, shape, and weight for handling materials safely?

(16) Are gloves or hand leathers used to protect hands where possible?

(17) Do workers try to lift or carry objects that are too heavy for them to handle safely?

2. LADDERS

Ladders are used so frequently and for so many varied jobs, it is not surprising that ladders directly or indirectly cause many workers to be injured every year. One or more subcommittees should be appointed to make a survey of all the ladders in the plant and report on their condition. These reports might be based on such questions as:

(1) Are there many places in the plant where fixed ladders should replace portable ladders?

(2) Is there sufficient clearance back of each fixed ladder so the worker gets a firm foothold on each rung?

(3) Are there any obstructions in front of any fixed ladder against which workers might bump their heads?

(4) Are fixed ladders in good condition and comparatively free from rust?

(5) If the fixed ladder is used to get onto an elevated level, are the ladder side rails extended beyond the elevated level to help workers when leaving or mounting the top of the ladder?

(6) Are portable ladders in good condition?

(7) Make sure that paint does not hide ladder defects.

(8) Are rungs on all ladders equally safe?

(9) Do all portable ladders have nonslip bases in good condition?

(10) When necessary, do ladders have hooked tops?

(11) Is the spreader on each stepladder in good condition?

The Safety Committee should also recommend that all unsafe ladders be either destroyed or repaired.

NATIONAL SAFETY COUNCIL, INC.
Chicago

Exide-Ironclads bring out the best in your electric industrial trucks

Trucks illustrated made by the following companies:

1 Automatic Transportation Co., Inc.
2 Baker-Raulang Company
3 The Elwell-Parker Electric Company
4 The Yale & Towne Manufacturing Co.
5 Mercury Manufacturing Company

POWER, Speed, Ruggedness, Long Life, Economy—these are built into the modern electric industrial truck. In order to turn these features to day-in and day-out advantage in your plant, select a battery possessing the same features. Standardize on Exide-Ironclad.

With their high power ability, Exide-Ironclad Batteries can give your material handling units practically unlimited power when needed. And their sustained voltage assures productive speeds every hour of the day.

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THE ELECTRIC STORAGE BATTERY CO., Philadelphia
The World's Largest Manufacturers of Storage Batteries for Every Purpose
Exide Batteries of Canada, Limited, Toronto

You want to know

and the editors will gladly tell you more about the things mentioned on this page

• TYPEWRITER RIBBONS impregnated with aluminum powder make it possible to type on blueprint and similar dark papers. (7701)

• CYLINDER LOCK for steel doors comes flush with outside door plate when assembled. Key serves as both key and handle for, after insertion and quarter turn to open lock, it remains there until lock is closed again. (7702)

• TRANSFORMER-RECTIFIER unit provides 6-volt d.c. power supply for power relay operation. With it around, there'll be no need to buy transformers and copper oxide rectifiers separately and combine them. (7703)

• TO RETARD mildew, fermentation, and mold growth in vegetable gums, casein, glue, gelatin, and the like, two new powders can be used. Use them dry or in solution. (7704)

• SKETCH PAPER, 8½ x 11-in. size, said not to deteriorate with age, has 7x7½-in. drawing area laid out in one-eighth-inch squares with inch lines heavy and numbered. Black ink or pencil marks stand out distinctly and make clear blueprints. (7705)

• HOW TO OPERATE the modern, lathe and machine the new metals, alloys, and plastics is told in a 272-page manual bound to be a reference for all shop men, both experienced and beginners. (7706)

THIS little lady's desk-side companion helps her sort, file, and organize her work. Papers up to 14 in. in length can be accommodated in the metal tray which has an adjustable follower. The tubular steel stand is 30 in. high. (7723)

• DO YOU HAVE to twist your neck and bob your head all around to read water level gages? If so, try the new neon tube and magnifier which is intended for mounting behind the gage glass. It makes the liquid-filled portion stand out as a broad red band. (7707)

• LAMP FILAMENTS, double-coiled, used for some time in gas-filled lamps, are now being used in Mazdas. They increase light output for rated wattage and maintain candlepower better throughout lamp life. (7708)

• PROCEEDINGS of the convention of the International Association of Industrial Accident Boards and Commissions have been published in a booklet "Discussion of Industrial Accidents and Diseases." (7709)

• INSULATING MATERIAL is being produced by heating a certain mica-bearing mineral to high temperature for a definite time interval. It's cork-like, is being made up as loose-fill insulation, insulating plaster, acoustical plaster, roofing, and flooring. (7710)

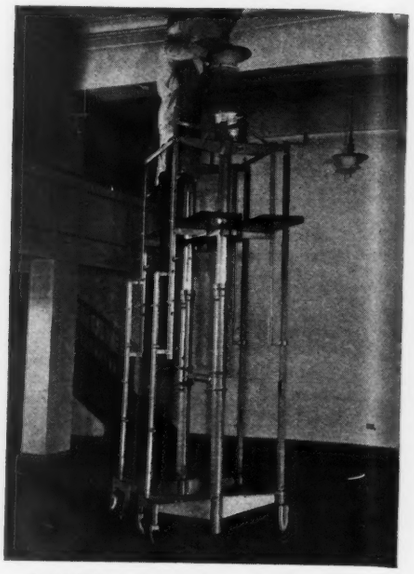
• PREPARED especially for safety engineers and workers whose task it is to eliminate fire losses is a pamphlet on the chemical and physical elements of fire and the proper way of combating all types of fires. (7711)

• WATERPROOF PAPER, waterproofed to a high degree, is said to do those things which are difficult for papers of the type—fold, print, and glue readily. (7712)

• PLASTICS MOLDING—how a molding job is tackled—is described in a booklet. Various plastic materials and their properties are mentioned and there are hints on design. (7713)

• SCREWDRIVER, non-skid, drives and removes screws with half the effort required in the ordinary screwdriver. Its patented point grips the inside of the screw slot and will not slip out easily. (7714)

• DIRECTORY of trade associations lists more than 2,400 of them. It lists them alphabetically, by commodity or service, by cities, and lists government agencies serving these associations. (7715)



RAISING, lowering, and moving about can all be done from atop this scaffold. With it possible to service work up to 22 ft. high with one of the two models, there's no end of maintenance tasks within its reach. Made of steel, it's easily taken down and put up, and operates hydraulically. (7724)

• TIME-STUDY MEN should itch to get their hands on a wrist watch-chronograph which shows time of day and checks operations in fifths of seconds or decimals of minutes. (7716)

• HANDBOOK showing standard method of drawing various types of bolts, nuts, and rivets fits into a drawing instrument case. (7717)

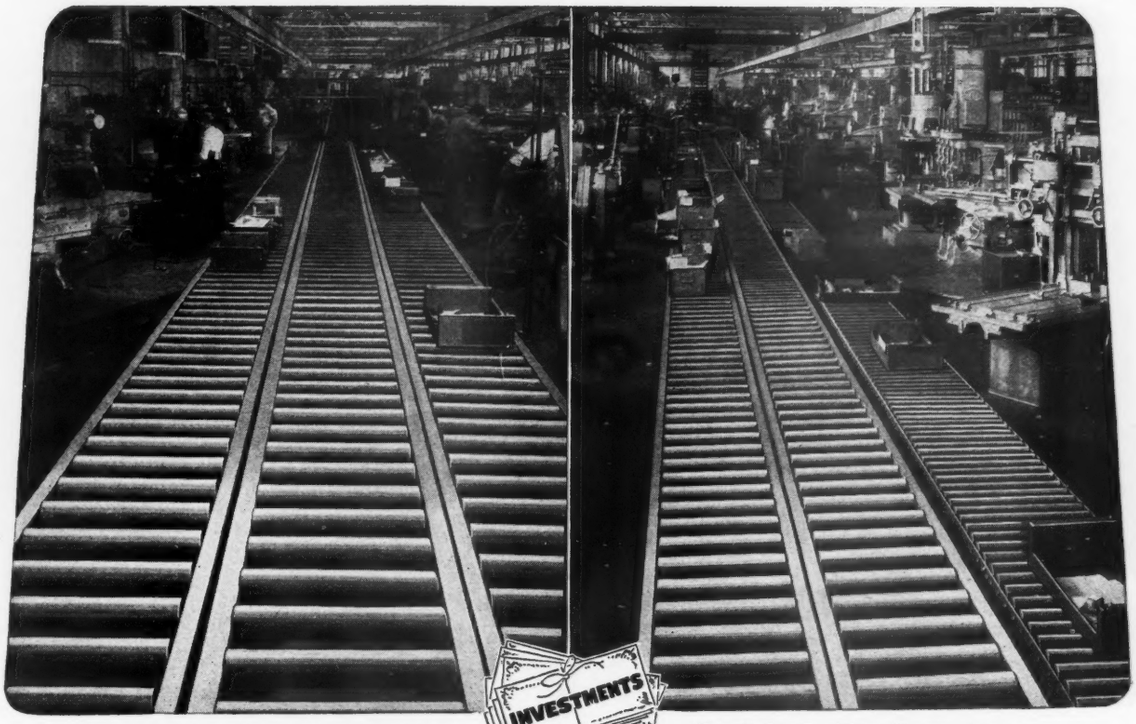
• PLASTIC CEMENT, newly compounded, is said to do a real job on mending leaks in oil containers. Repairs resist temperatures to 350 deg. F. (7718)

• THE TELEPHONE CORD that gets so badly twisted you can't draw the phone to you need trouble no longer. Conductors are braided around a central elastic core in such a way that this new cord will stretch to twice its length when pulled, and return to normal without kinks. (7719)

• GREASE compounded with lead powder, when used in bearings, results in less wear and less packing, it is claimed. The lead powder used in pipe-joint compounds is said to give a corrosion-preventing coating on the threads and prevent freezing of the joints. (7720)

• ANTISEPTIC MATERIAL, packaged like a lipstick, is handy to have around to rub on scratches. (7721)

• "AIR CONDITIONING SOAP" leaves its users with a cooling sensation. It contains no alcohol, but its effect is like that of an alcohol rub. (7722)



No time lost by these machines. Center lines of conveyor are Live Rolls which convey material between operations. Material transferred to side lines of idler rolls while machine operations are performed, then back to main line. Below: A "loop" from main line to a special operation.

Do you **ALLOW** *your expensive machines to give you* **100% RETURNS ?**

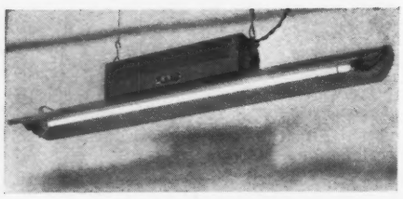
GIVE YOUR machines a chance! . . . A machine that's intermittently idle sixty minutes a day—loses an hour's productivity. *Yet this is a loss that goes unnoticed in many plants.* . . . Machines can work continuously when a well-planned system of Logan Conveyors (1) eliminates delays by keeping an ever ready supply of material handy, (2) delivers material at convenient working height, (3) quickly dispatches the semi-finished product to the next operation. . . . Helping the customer get value-received from his expensive machines is but one of the profit-paying functions of Logan Conveyors. Send for graphic presentation of major advantages as covered in bulletin "7 Economies". Write on your letterhead today. Or call in the nearest Logan engineer.

LOGAN CO., Incorporated
510 Buchanan St., Louisville, Ky.

HELP YOU GET OUT THE WORK

Logan Conveyors
LOUISVILLE

What's NEW in Equipment



Mercury Lamps

Mercury lighting units of the long-tube type. The "50-in. light source" operates at 350 watts a.c. The "33-in. light source" operates at 280 watts. Equipped with newly designed enameled reflectors, the complete lighting units are said to have an overall efficiency of about 15 lumens per watt. Reflector and tube are intended for mounting in a true horizontal position. Starting and restarting is instantaneous. Tube connections are made with insulated screw terminals. Is said to be suitable for precise seeing tasks requiring a minimum of shadow and glare and a maximum of detail-revealing clarity. Starting current is said to show no initial surge above operating level. General Electric Vapor Lamp Co., Hoboken, N. J.

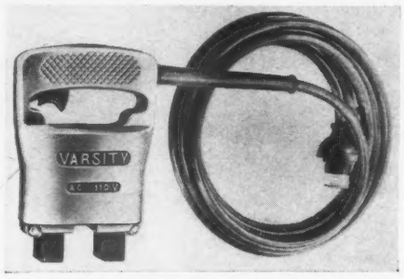
Telephone

"Cal-Fon" intercommunicating telephone is a two-way communicating system operating from dry cells or storage batteries, to which any number of stations may be connected. Consists of a French handset and a switch button on which the weight of the handset rests. It is neutral when not

in use. When the phone is lifted, the circuit is closed for talking. The button, when depressed by the finger, becomes the call bell. Housing also contains a buzzer and the transformer, so that any number of phones can be used on one circuit by coding the rings. Standard equipment for the desk model includes a bracket so that it may be used either as a desk type or hung on the wall. Universal Microphone Co., Inglewood, Calif.

Magnet

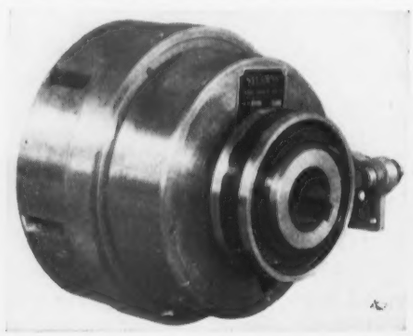
An electric hand magnet which operates from any 110-volt, a.c. light socket. It has a trigger-type switch, making it very easy to use, and it is light in weight. It is used for sorting metals, removing free iron, and detecting iron. Can be used



as a safety device inasmuch as it can be used to pick up nails lying loose and in cleaning up iron turnings and chips around machines. Metallurgical Products Co., 35th and Moore Sts., Philadelphia.

Clutch

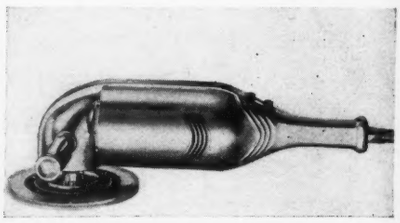
Style "E" magnetic clutch can be used for universal wet or dry applications and is of compact, simplified design. Automatic self-alignment at all times is claimed.



Cage floats around friction elements, eliminating possibility of uneven wear on any part of the unit. Has simplified latch and groove lock design which provides easy adjustment. Removal and replacement of lining is said to be a comparatively simple operation. Stearns Magnetic Mfg. Co., Milwaukee.

Sanders

Two models of 7-in. disk sanders—one for heavy duty, one for constant production service—can be used for removing weld marks; removing rust and dirt; finishing tile, concrete, and stone surfaces; and for metals. Air filter protects commutator and motor from abrasive dust and dirt. Straight-line ventilation makes a cool-running tool. Ball bearings are fully sealed. Heavy



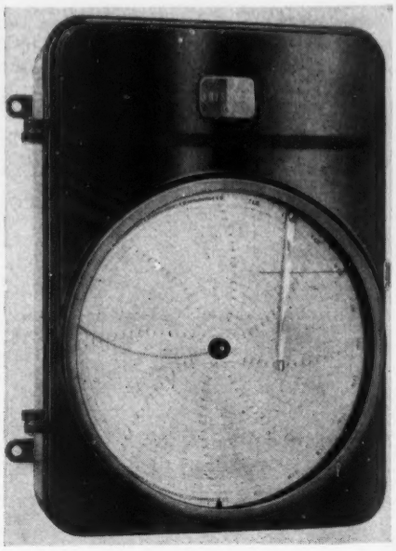
duty model G is 16¾ in. long, weighs 12½ lb. Model L is 16¾ in. long, weighs 14 lb. Both models have die cast aluminum alloy bodies. Skilsaw, Inc., Elston Ave., Chicago.

Aluminum Paint

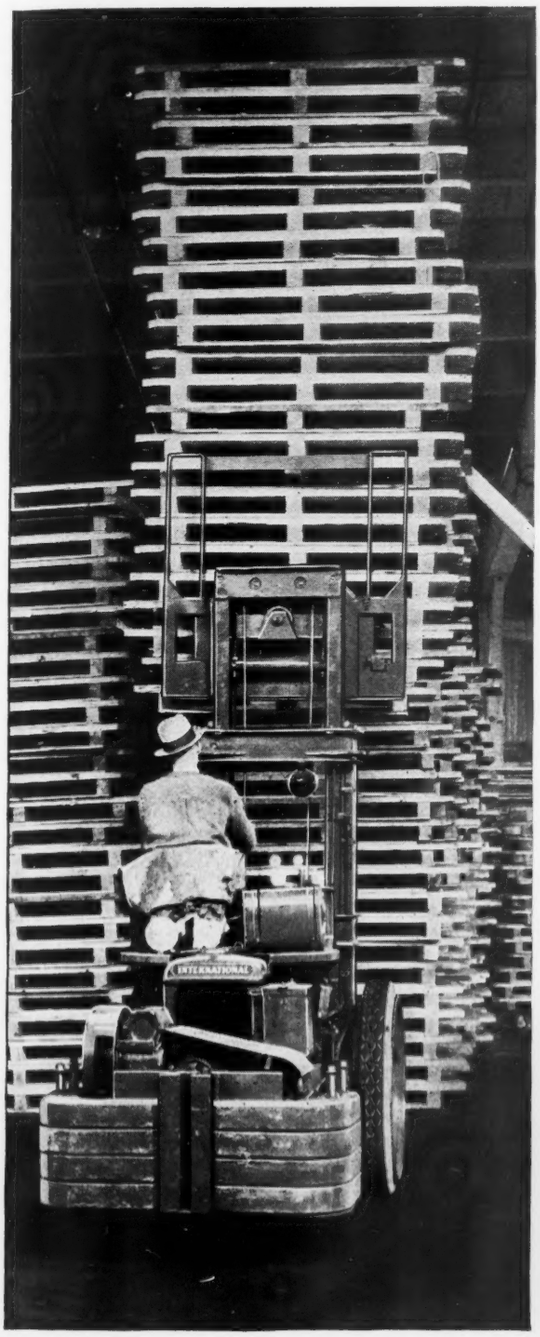
This paint for metal surfaces prevents rust and resists heat. It penetrates into cracks and holes to give a continuous surface with a shiny gloss. Is supplied in paste form in a two-compartment container with vehicle in the second compartment. After mixing, it is applied by brush or spray gun. Dries in about 6 hr. Samuel Cabot, Inc., Milk St., Boston.

Potentiometer

Round-chart recording potentiometer is known as the "Pyromaster." Is available as pyrometer, tachometer, resistance thermometer, millivoltmeter and milliammeter. Requires no lubrication, is not affected by normal plant vibration, has no mechanical



When RESULTS *are Needed*
Specify INTERNATIONAL Power



One of 12 International I-12 Tractors equipped with lift truck operated by the Western Transportation Company, Portland, Ore. This scene was taken on the Oceanic Terminals wharf in Portland and shows the tractor handling a large, bulky load.

● Let this sound advice from *experienced* users direct your purchases of industrial tractors and power units. Cash in on the advantages INTERNATIONAL *Performance* and INTERNATIONAL *Economy* bring to the job — advantages that make you feel mighty good when the cost sheets are figured.

International Industrial Power has a reputation for getting things done fast . . . that's why you find the *big* jobs being turned over to International. And when service is needed, the low maintenance cost of each unit in the International line means unusual savings. Wheel and crawler tractors (gasoline and Diesel) for mobile power, and power units (gasoline and Diesel) ranging up to 110 max. h. p. for stationary work are available. See the nearby International industrial dealer or Company-owned branch for complete information.

INTERNATIONAL HARVESTER COMPANY
(INCORPORATED)
606 So. Michigan Ave. Chicago, Illinois

Right: The heart of this outfit servicing the Zephyr is an International Power Unit. These units range in size up to 110 max. h. p., gasoline and Diesel. International Power is cutting costs on countless jobs.

This International I-12 Tractor works for Case Crane & Kilbourne Jacobs Co., Columbus, Ohio. It hauls all kinds of loads around the plant, pushing as well as pulling.

INTERNATIONAL Industrial Power

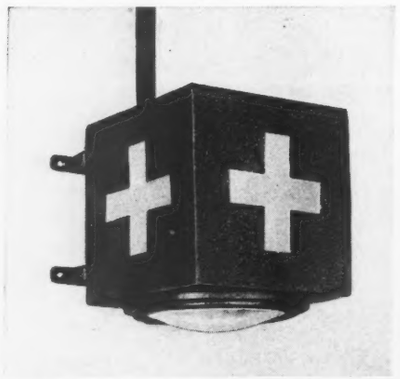
motion of any kind, except when a change in measured quantity takes place. It can be used under rough conditions where air is laden with dust, moisture, or corrosive fumes. Operating mechanism is made of five small, compact units which are replaceable. There are no mechanical connections between the galvanometer unit and other units. The Bristol Co., Waterbury, Conn.

Balancing Equipment

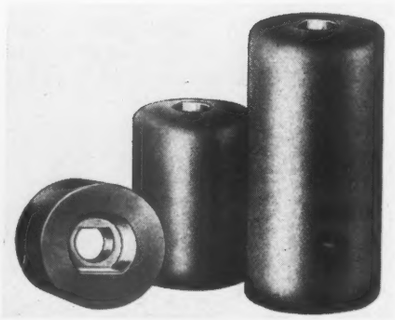
This portable equipment is suitable for balancing turbines, fans, exhausters, pumps, and motors. The model S2 Vibrometer, which measures in two directions simultaneously and indicates wave form, enables record of turbine vibration to be made periodically. There is also a single-direction Vibrometer. Model 3 stroboscopic lamp has three neon tubes, although equipment with a single lamp is available. Synchronous motor unit is used for balancing 60-cycle machines running at 3,600, 1,800, or 1,200 r.p.m. With it, it is unnecessary to couple breaker head to machine shaft and the motor and breaker head may be placed at any point most convenient to the operator. For machines running at other speeds, the breaker head is driven from the end of the shaft by a tachometer point. Electrocon Corp., 6 Varick St., New York.

Stretcher Lantern

Provides a distinctive signal to illuminate stretcher locations. Besides being valuable in case of accident, it serves as constant warning of danger and the need for



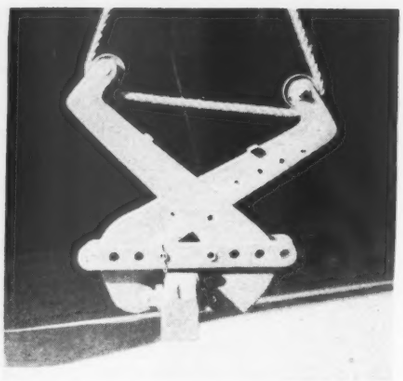
safety. Is mounted on wall above stretcher with lens facing downward. Brightly illuminated green crosses on the three exposed sides give a clear signal regardless of the distance or angle of vision. Constructed of 18-gage steel with white enamel interior, it is dust and weatherproof. The 6½-in. lens in the bottom supplies illumination of the stretcher cabinet. Hinged door allows for easy light replacement. Fittings are furnished with ½-in. conduit connection. Lamp used can be 25-, 40-, or 50-watt. The Lintern Corp., Cleveland.



Flexible Coupling

Made of soft live rubber to absorb shock and vibration. Flat spots molded into ends fit securely over flats of shafts, eliminate set-screws. Light in weight and said not to throw small rotors out of balance. Said to be silent in operation. Furnished in 13 lengths between 1¼ and 4¼ in. Bore sizes available range from ¼ to ⅝ in., with seven sizes available. Henry Engineering Co., 1401 Sangamon St., Chicago.

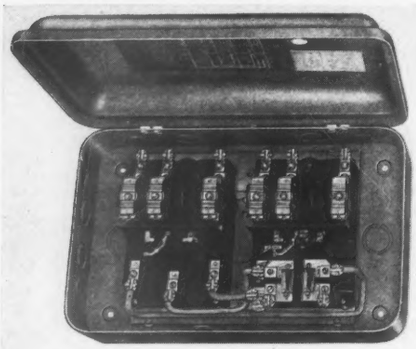
Grip



This materials handling grip is so designed that it may be landed on load or taken off with a crane without the operator actually touching the grip, any more than to use a chain or small rod to pull the latch which releases or locks the jaws. Is adjustable to take large range of sizes. Smith Devices, 2245 North 12th St., Philadelphia.

Starter

Size 2, type "MR" a.c. motor reversing starter. This is a new model in the company's line of remote control, across-the-line starters of this type. "Stop-reset" button projecting through cover is intended for resetting thermal overload relays after



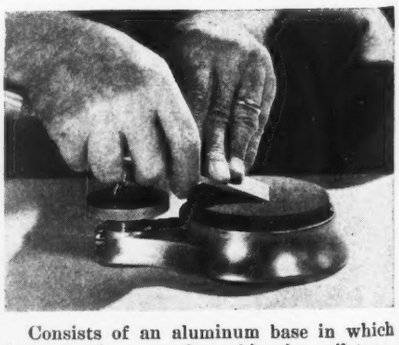
they have opened the switch following a sustained overload on the motor, but may be used to stop the motor at the starter. Rated 50 amp.; voltages from 110 to 600. Horsepower ratings 7½ to 25. Hart & Hegeman Division, The Arrow-Hart & Hegeman Electric Co., Hartford, Conn.

Flow Meter

Electrically operated flow meter called the "Synchro-Meter" consists of a transmitting unit containing flow measuring mechanism and a receiver consisting of the

indicating, recording, and integrating instruments. Transmitter is located at point of measurement and receiver is located at place convenient for reading. It is said no adjustments are necessary at the transmitting end, and that calibration of the transmitting system is simple. Three wires are required to connect transmitter and receiver. With No. 12 wire the two can be located approximately one mile apart. Alternating current at from 95 to 125 volts is required, at a frequency of 25, 50, or 60 cycles. Bailey Meter Co., Cleveland.

Oil Stone



Consists of an aluminum base in which is inserted a round combination oilstone, coarse on one side for fast grinding and very fine on the other side for finishing or honing. Adjacent to the stone is a bronze table with steel top or insert. Table is adjustable, up or down, by means of a fine threaded support. A bronze toolholder is fitted with a steel post which rides on the steel topped table. Bottom of post is provided with a steel ball to minimize friction and wear. Any kind of straight-edged tool

IN COME NEW *Elwell-Parkers* TO HANDLE BAGGED PRODUCTS . . . *and*

bags are moved faster, are tiered higher, and pay loads are transported both ways!

The picture shows one ingenious method of large-volume handling of bags. Another and more recent installation of an Elwell-Parker System of Materials-Handling* in a different industry is accomplishing outstanding results also.

UNIT VOLUME. Each trip, the Truck transports 30 filled bags of 100 lbs. each. Average net load per trip, 3000 lbs.

DAILY VOLUME. In an 8-hour day, the Truck averages 160 round trips and handles 4800 filled bags—480,000 lbs.—an average of 600 bags per hour.

TWO PAY LOADS EACH TRIP. In addition to delivering the above daily tonnages *into* storage, the Elwell-Parker Truck brings back equivalent loads *from* storage to railroad cars or motor trucks. These "return loads" average 320,000 lbs. per day—or a two-way pay load totaling 800,000 lbs. each 8 hours.

Elwell-Parker has been originating and applying progressive methods of materials-handling for more than 30 years. Today it is enabling customers in all major fields to reduce these costs sharply, by providing modern, re-designed Trucks, Tractors and Cranes capable of moving larger loads, at greater speed, with safety to men and machines.

Your nearby Elwell-Parker Engineer is available for consultation with your own Engineers. Send for him. The Elwell-Parker Electric Company, 4323 St. Clair Avenue, Cleveland, Ohio.

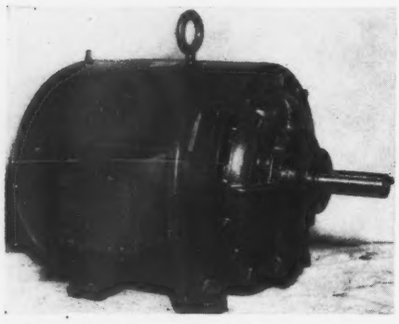
* **Elwell-Parker Trucks of correct type and capacity, together with the proper attachments, and a soundly-engineered plan of operation.**

New Type **ELWELL·PARKER** *Trucks*

ESTABLISHED 1893 • BUILDING POWER INDUSTRIAL TRUCKS SINCE 1906

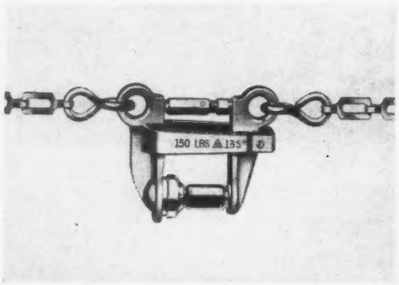
of chisel type 2½ in. wide or less can be inserted in toolholder. After adjusting for the proper bevel, the tool is pushed back and forth across face of the stone. Lombard & Co., Winter Hill Station. Boston.

Motors



Type CS fan-cooled squirrel-cage motors. Heat exchanger principle is used for cooling. An internal fan on the rotor circulates warm internal air through internal ducts, the walls of which are cooled by the external fan blowing larger volumes of cool air through external ducts, providing rapid transfer of heat from the motor. Housing is designed so that fresh grease enters the outside edge at top of bearing and excess or used grease is discharged at the bottom inner edge to the overflow sump. In this way fresh grease automatically cleans used grease from the bearings, making it unnecessary to periodically dismantle the motors to clean the bearings. Westinghouse Electric & Mfg. Co., East Pittsburgh.

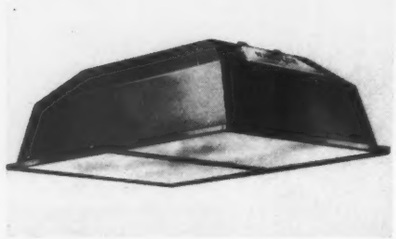
Releasing Device



"Quartzoid" is a heat-operated releasing device. It can carry loads up to 150 lbs. The bulb, extremely sensitive, yet immune to corrosion, completely shatters at its rated temperature. Its ability to carry a load eliminates the necessity of ganging several solder links where unusual weight must be resisted. Grinnell Co., Inc., Providence, R. I.

Reflector

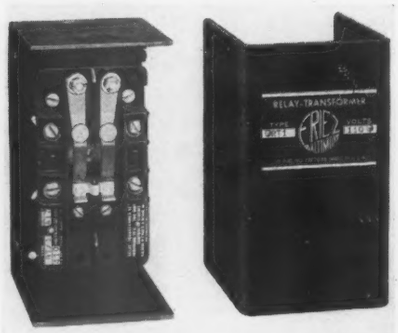
"Panelite" provides a large area, low brightness light source which is suited for inspection work and close work on shiny surfaces. Has four sockets in which lamps ranging 25-100 watts can be used. Opal glass diffuses the light. Cast aluminum hinged doors make easy access to lamp. Supporting flange is for ¾-in. pipe and provides rigid support for the unit. Is porcelain blue outside, white inside. Wheeler Reflector Co., 275 Congress St., Boston.



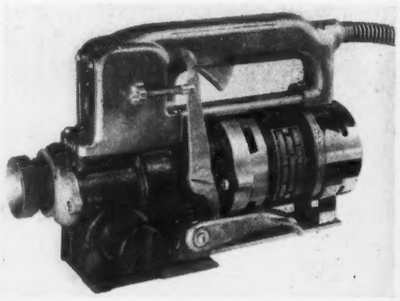
Carboy Dumper

"Carboy Dumper" picks up carboy and empties it completely into bucket or other receptacle. Two centers of rotation enable the pouring stream to take place in a single spot, so carboy can be emptied without moving the bucket from its original position. Operator is always at a safe distance from bucket so that he is protected from burns or fumes. Mounted on rollers. One man can easily pour out the necessary quantity of acid without help. Belke Mfg. Co., 947 North Cicero Ave., Chicago.

Relay-Transformer



Relay-transformer set makes it possible to obtain a relay for handling electrical loads up to ¾ hp., or 1,000 watts, and at the same time a transformer at a cost no higher than for a simple relay alone. In this way, the electrical load to be handled remains on line voltage of 110 or 220 volts, while the control instrument (thermostat, humidistat, or effective temperature control) is at the same time placed on low voltage (20 volts). This lowers cost of installation. The same coils which operate the relay produce the low-voltage supply. Whole assembly is one unit and is compact as a simple relay alone. Julien P. Friez & Sons, Inc., Baltimore.



Strapping Tool

Electric strapping tool tensions strapping around large and heavy packages and bulk shipments where speed and minimum effort in applying maximum tension are needed. Powered with a universal reversible electric motor. An adjustable control provides the required tension on the strap automatically, eliminates guesswork and assures uniform tension. Can be operated with either hand, and has finger-tip control. Full-length base with rounded front edge enables the tool to ride smoothly over cross-strapping or uneven surfaces. Signode Steel Strapping Co., 2600 North Western Ave., Chicago.

Protective Coating

"Ne-Ver-Rust" is a thin transparent liquid composed of mineral greases which can be applied to machine and polished surfaces to protect from rust. Can be applied by brushing or dipping, removed with any paint solvent. Will not injure polished surface; sets sufficiently to handle within a couple of hours. The Never Rust Mfg. Co., 1770 East 18th St., Brooklyn, N. Y.

Tubing

Stainless steel tubing, made by double-lock, spiral-seam method, has smooth inner wall to prevent particles in materials being conducted from adhering to tubing. Can be used in air conditioning, chemical, and food fields. Offered in diameters ranging 2½-7 in. Ludlum Steel Co., Watervliet, N. Y.

Ozone Generator

"FO" ozone generator destroys odors and freshens air in plant rooms or offices. Comes in two sizes, one capable of supplying ozone to 8,000 cu.ft., the other,

SHAFER

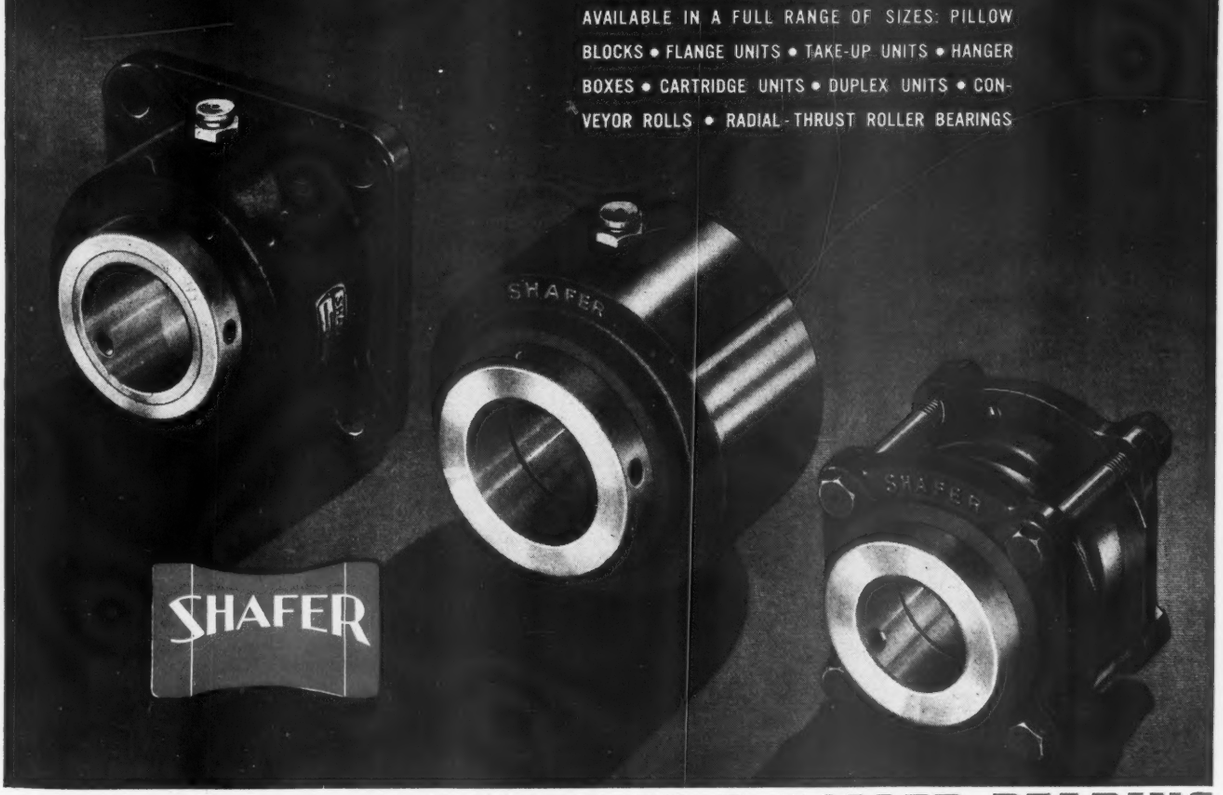
self-aligning ROLLER BEARING UNITS

offer a simple and direct solution of all problems of bearing alignment. In welded construction this feature is especially valuable. Shafer units are easily installed; handle radial, or thrust, or combined radial-thrust loads; and automatically compensate for mounting inaccuracies with self-alignment within the bearing itself.

Shafer Bearing Corporation

35 East Wacker Drive, Chicago

AVAILABLE IN A FULL RANGE OF SIZES: PILLOW BLOCKS • FLANGE UNITS • TAKE-UP UNITS • HANGER BOXES • CARTRIDGE UNITS • DUPLEX UNITS • CONVEYOR ROLLS • RADIAL-THRUST ROLLER BEARINGS



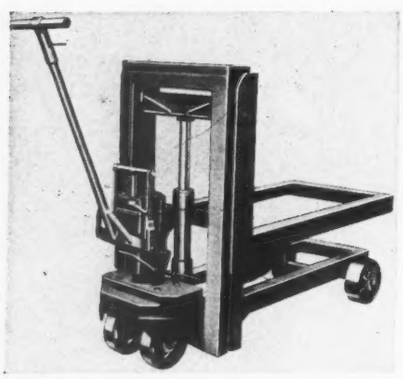
EVERYTHING YOU NEED IN A ROLLER BEARING

20,000 cu.ft. Has "Roto-Beam" circulator which builds up a spiraling air stream, giving fast and wide volume of air distribution. Housing panels are of black plastic trimmed in chromium. Electroaire Corp., 1455 West Congress St., Chicago.

Air Eliminator

High-pressure air eliminator will automatically vent driers, steam coils, traps, etc., under varying steam pressures up to 150 lb. Operating member is made of noncorrosive metal sensitive to heat changes, making it positive in operation. Operating member closes the valve at 212 deg. F., and keeps it closed until temperature drops below that point, when it automatically opens the valve. Made of nickel-plated bronze, it is 2½ in. in diameter, 4⅝ in. high over all, and has ½-in. bottom pipe connection. Air outlet is 3/16 in. in diameter. Gorton Heating Corp., Cranford, N. J.

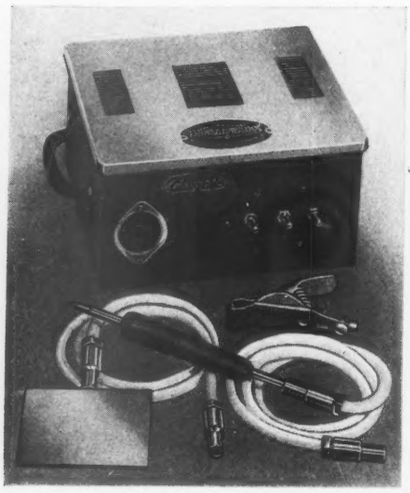
Lift Truck



Hydraulic lift truck has 10-in. elevation with cantilever-type elevating frame. The truck shown is rated at 3,500 lb. capacity, having 9-in. lowered height, 19-in. elevated height, and a carrying platform 24 in. wide by 42 in. long. Lyon Iron Works, Greene, N. Y.

Soldering Flux

"Tinol" is a liquid which will penetrate films of oil on a metal surface. It can be diluted in the ratio of 1 part to 6 of water or alcohol. American Solder & Flux Co., Wayne Ave. and Berkley St., Philadelphia.

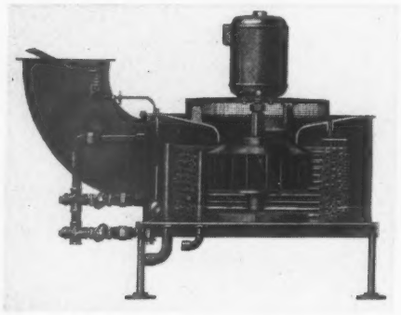


Demagnetizer and Etcher

Company's "Demagnatool" and "Etchograph" have been combined into a combination tool. It is said that the etcher, while in use, produces no magnetism, but frequently reveals its presence, and thus with the combination device means are at hand to remove the magnetism and do the marking all at once. The demagnetizing element demagnetizes to zero by simply passing the equipment through the flux. William Brewster Co., Inc., 50 Church St., New York.

Refrigerant Condenser

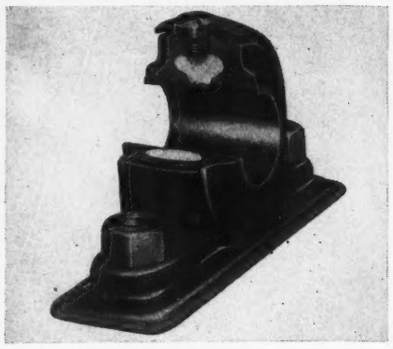
"Hydrocyclonic" evaporative type condenser is designed for use on methyl chloride and Freon-12 installations. It is self-contained and includes a complete assembly of tank, condenser coil, motor fan, water lift, float control, and water valves. Circular tank has side outlet ell for air discharge from the condenser coil. This ell is flanged for connection to a discharge



duct and a self-acting damper prevents outside air from entering the condenser body through the ell when the equipment is not in operation. Condenser coil, consisting of a series of flat pancake coil sections, is installed in the tank and connected to a refrigerant inlet header on the outside of the coil and a liquid outlet header on the inside end of the coil. Each coil section slopes downward. Vertical, rubber-mounted, totally inclosed motor is supported over the air inlet tunnel forming the top of the tank, and drives a special fan attached to the bottom of motor shaft extension. Coil can be cleaned by submerging in water. There are no nozzles and no pump is required. Three sizes, covering a range from 15,000 B.t.u. per hr. minimum to 120,000 B.t.u. per hr. maximum. General Refrigeration Sales Co., Beloit, Wis.

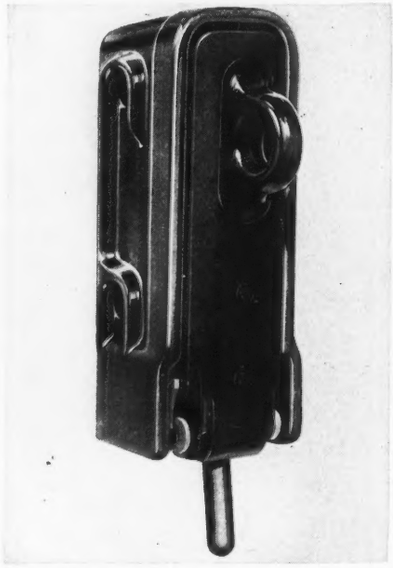
Bearing

Cushioned vibrationless bearing is designed for use in fan and blower service. Noise from rotating parts and vibration resulting from unbalanced rotors or couplings is absorbed by band of Neoprene inserted between the inner unit and the outer casing. It is self-oiling, oil from the shaft coming by capillary action from the reservoir contained in the cast iron inner housing. Dodge Mfg. Corp., Mishawaka, Ind.



Disconnect Switch

Features of this new switch are instant indication of open or closed position, complete weather protection. Adjustable switch plate remains inside plastic door, whether in open or closed position. Switch blade is pulled free of contact clips when door is pulled open. When switch is to be kept open, blade is lowered into open position and locked, the door reclosed with all contact parts free, yet fully protected from the weather. Indicator protruding from



base of housing indicates open position. When circuit is to be reclosed, door is again pulled open and blade raised from open to closed position and locked, the door reclosed, and contact restored. In 75- and 200-amp. sizes. Line Material Co., South Milwaukee, Wis.

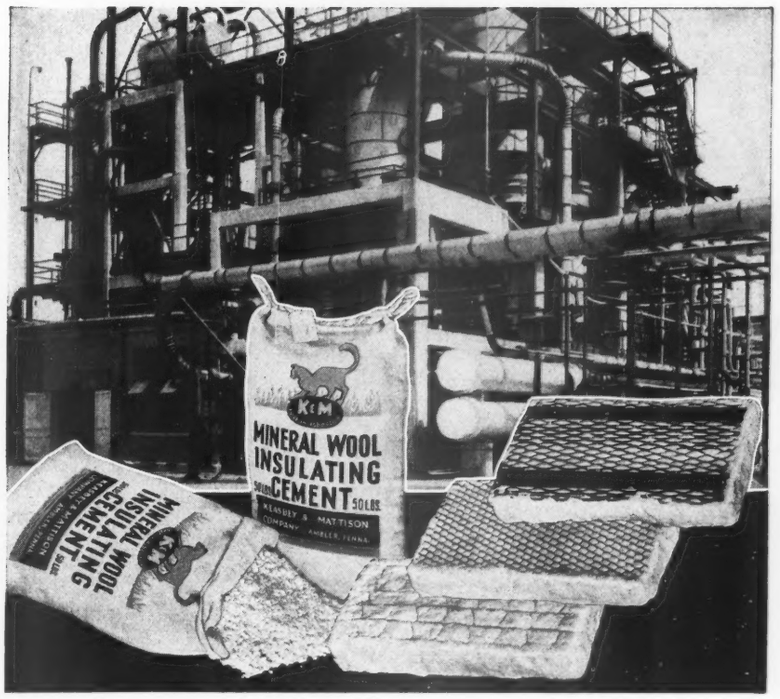
Contactor

Size 00 Type CR2810 a.c. multi-pole magnetic contactor for controlling small single-phase and polyphase motors, or for use as a flexible relay device. Can also be furnished as a magnetic switch (Type

Fire-resisting . . . . .

. . . . insulating

blankets and cement



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K & M Mineral Wool, made literally from molten stone, is not only a highly effective heat insulator for temperatures up to 1600° F.... it is chemically inert, incombustible and rot-proof. It comes in the form of blankets, insulating cement, and is also available in granulated and loose form.

This is but one of the many highly specialized K & M products of exceptional uniformity, durability and physical properties, reflecting the extensive background of this Company in the production of insulating materials of all kinds. The K & M line is complete, and priced right.

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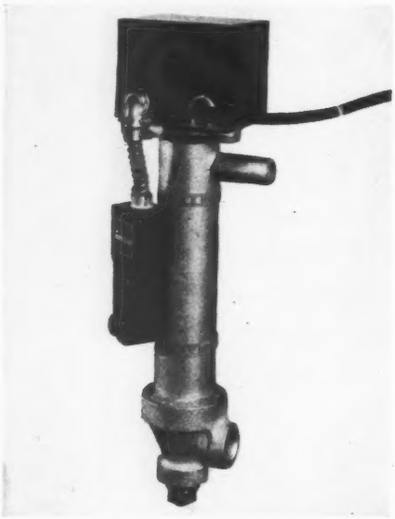
AMBLER, PENNA.

CR2811) mounted in a small sheet-metal case suitable for general-purpose application. Either as contactor or switch it has a maximum rating of 10 amp. at 600 volts. Silver double-break contacts. Flash-overs between poles are minimized by large hot-molded arc barriers. Contactor is available with minimum of two poles and maximum of eight. Can be furnished in any combination of normally open and normally closed poles. All types of cases have conveniently located knockouts and ample space is provided for wiring. General Electric Co., Schenectady, N. Y.

Water Heaters

"Side-Arm" electric heaters for oil, water, or other liquids. Furnished with or without thermostat for automatic temperature control. Are especially designed for use as hot-water circulator heaters for heat-



ing apparatus and for furnishing hot water in isolated washrooms. They also make good oil circulation preheaters. Can also be used as steam generators when mounted at lower point of a closed steam system so that condensate keeps the heater elements covered. Insulated jackets can be furnished. Made in standard sizes rated at from 1 kw. to 5 kw. inclusive, for 115-, 230-, or 440-volt service. Edwin L. Wiegand Co., 7500 Thomas Blvd., Pittsburgh.

Wrenches

These heavy duty box socket wrenches are built to take abuse, says the manufacturer. Along with the line are available tubular extensions that slip over the forged handle and permit leverages up to 30 to 1. Striking sleeves can also be had, designed to protect handles when loosening or setting nuts in close quarters with a hammer or sledge. Wrenches are made of drop forged alloy steel, come in three styles: straight, 15-deg. angle, and offset. Heads have double hexagon openings ranging from 1¼ to 3½ in. Armstrong Bros. Tool Co., 317–357 N. Francisco Ave., Chicago.

Soldering Flux

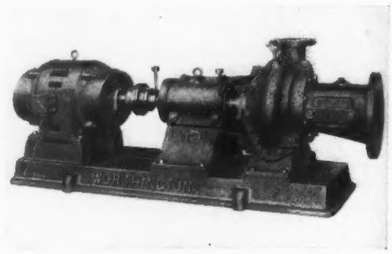
"Spekflux" is for use in hard soldering, brazing, welding. Dissolves metal oxides and spreads over surface to exclude air while soldering operation is performed. After mixing with water it is applied with a brush or by dipping. Excess material can be washed off with hot water. Special Chemical Corp., 30 Irving Place, New York.

Hoist

"Load Lifter Junior" is a low-headroom-type electric hoist built in sizes to lift 350 and 700 lb. Distance from bottom of the track on which hoist operates to hook when in its highest position is 12¾ in. Lifting speed of 20 ft. per min., with rated capacity loads, and hook lift of 18 ft. Control is by pushbutton contained in a unit suspended from the hoist. Gear train consists of only two gears and pinions. Ball bearings are used throughout. Motor is of totally inclosed type. There are two brakes, an electrically operated motor brake and an automatic mechanical load brake of the roller ratchet type that controls the load during lowering, so that lowering speed is approximately the same as hoisting speed. Gearing and mechanical load brake operate in an oil bath. Shaw-Box Crane & Hoist Co., Muskegon, Mich.

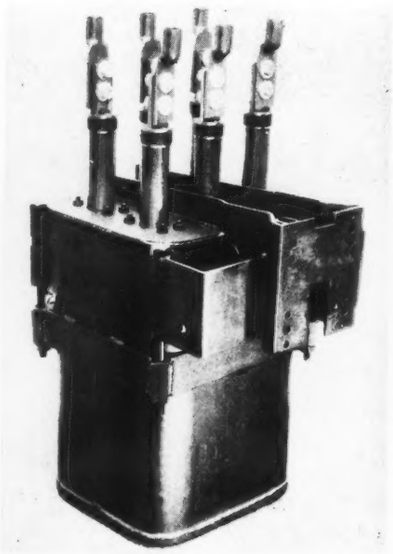
Pumps

Line of centrifugal paper stock pumps capable of handling high consistencies. Applicable to processes requiring a sturdily built, non-clogging, non-air-binding pump for continuous operation. Has angle-split



casing and bearing housing; also heavy oversize shaft mounted on ball bearings. Individual bearing housings are dirt-, dust-, and grease-proof. Has non-clogging impeller which consists of two combined screw and radial stream-lined vanes. Made in six sizes, their capacities range from 100 to 3,500 gal. per min. They operate at very low speeds against total dynamic heads of 10 to 160 ft. Worthington Pump & Machinery Corp., Harrison, N. J.

Circuit Breaker



Class TCR-1 indoor oil-tight circuit breaker of 75,000-kva. interrupting capacity. Available in the following ratings: 600 amp., 15,000 volts; 1,200 amp., 7,500 volts; 2,000 amp., 5,000 volts. The 600- and 1,200-amp. breakers are rated at 30,000 amp. for 5 sec. and 45,000 amp. for 1 sec. The 2,000-amp. breaker is rated at 40,000 amp. for 5 sec. and 50,000 amp. for 1 sec. Available for both automatic and non-automatic operation in both 2- and 3-pole types. Roller-Smith Co., 233 Broadway, New York.

Magnetic Separator

Type L magnetic separator can be used in treatment of any number of materials and for separating metal borings and turnings and reclaiming brass, bronze, and aluminum. Has self-contained drive, the motor being operated from any a.c. source. Unit is also equipped with a generator for use where d.c. is not available. The motor

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YES, we are and have been paint manufacturers since 1881. Yet we frankly say to you that paint is *not* the most ideal restoration agent for old concrete, masonry and stucco surfaces which have started to disintegrate.

More than 25 years of careful research and testing, both in the field and in the laboratory, have convinced us of this fact. Experience has clearly shown that to be effective and lasting, a decorative coating for old concrete and stucco surfaces must possess the following characteristics:

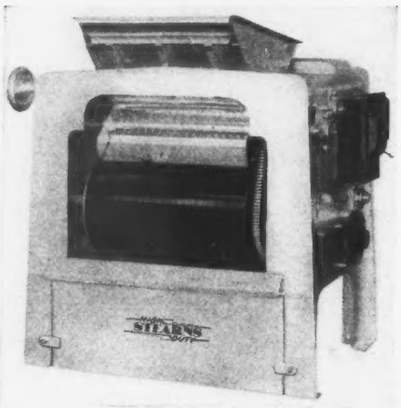
1. It must be tough and heavy enough (15 to 20 times the thickness of a paint film) to bridge and fill small cracks and provide ample insulation.
2. While its outer surfaces must set hard, its under surface must remain pliable indefinitely, so that it can expand and contract with movements of the building surface.
3. Its soft under surface must be able to heal its own outer surface injuries, thus tending to prevent the appearance of new cracks.

In DUM DUM MASONOC, The Arco Research Laboratories have developed a decorative coating that meets these exacting qualifications. Not a paint, it has been time tested for over 25 years and under all weather conditions. If this be treason, make the most of it by sending for a newly published book fully describing this decorative weather proof coating to Department F-7, The Arco Company, Cleveland, Ohio or Los Angeles, Calif.

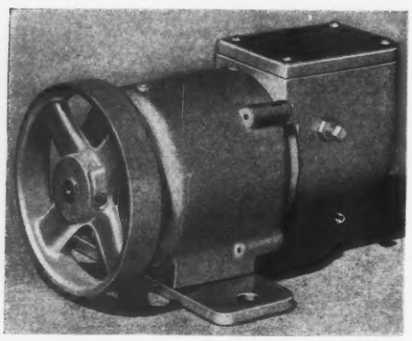
Sam Moore

Vice Pres., THE ARCO CO.

is sufficiently large to drive both generator and separator. All moving parts are protected, and anti-friction bearings are used throughout. Transmission is roller-chain type with cut steel sprockets. Can be transported readily with lift trucks. Stearns Magnetic Mfg. Co., Milwaukee.



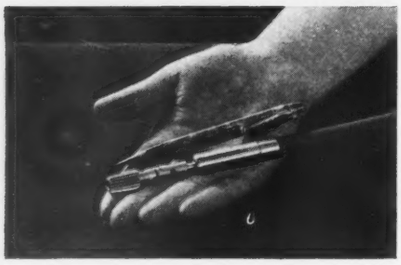
Relay



"Saf-Driv" relay is a foolproof unit for protection against motor drive or belt failure. If a drive fails upon which ventilation or processing depends, the relay will immediately sound an alarm or shut down the entire system. Is mounted so that pulley is driven by belt or drive being protected. Pulley drives a shaft carrying a centrifugal-type governor. When operating, the rotation force serves to tip a mercury switch to close the circuit. If drive fails, the mercury switch tips back to break the circuit and secondary relay operates to sound the alarm. Capacity: 10 amp. at 110 volts, 5 amp. at 220 volts. Speed ratings down to 700 r.p.m.: lower speed ratings can be had on special order. General Combustion Corp., Engineering Bldg., Chicago.

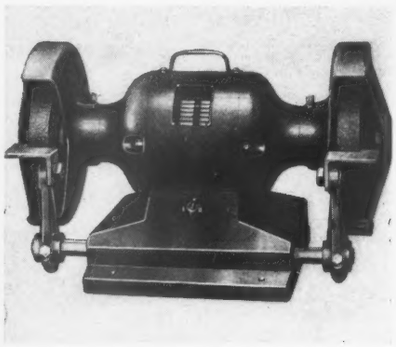
Tube Cleaners

These tube cleaners, the "600 Series," are for small tubes such as found in condensers, heaters, heat exchangers. Made in a range of motor diameters from 15/32 to $1\frac{7}{16}$ in. Can be used for straight and curved tubes. Operate on air pressures up to 100 lb., consuming from 10 to 30 cu. ft. of free air per minute. They may also be operated by steam. It is not claimed that they will remove a heavy, hard accumulation, but they will remove a soft accumulation, or a thin, fairly hard accumulation. Cutting tool is a threaded cone cutter attached to a threaded adapter by means of a universal joint. Elliott Co., Jeannette, Pa.

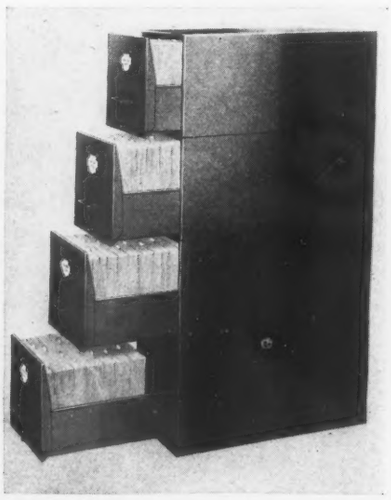


Grinder

Heavy duty electric grinder for general grinding and polishing operations. Has cast iron base arranged for fastening to bench or table. Also has handle secured to motor yoke to provide portability. Adjustable steel toolrest may be set in any grinding position to compensate for wheel wear. Heavy steel wheel guards completely inclose wheel, except for working sector. Guards are adjustable to permit use of entire circumference of wheels. Two 7x1-in. wheels, one coarse grain, the other fine, are furnished. Motor is totally inclosed, of $\frac{1}{3}$-hp. capacity, 3,450 r.p.m., 110 volts, 60 cycles, single-phase. Diehl Mfg. Co., Elizabethport, N. J.



Steel Transfer Case



Designed for storage of old records, this unit is complete in itself or usable with others in a storage system. It is made in both letter and legal size widths and has maximum depth of $27\frac{1}{8}$ in. Two steel angles, one at each upper corner, give strength to the unit. Drawer operation is smoother than on old model and a stop prevents the drawer from being pulled out too far. A second stop prevents the drawer from being pushed too far in and against back of the case. A $\frac{3}{4}$-in. bead along drawer top acts as a reinforcement and protection for hands. Known as the "Aurora" unit. All-Steel-Equip Co., Aurora, Ill.

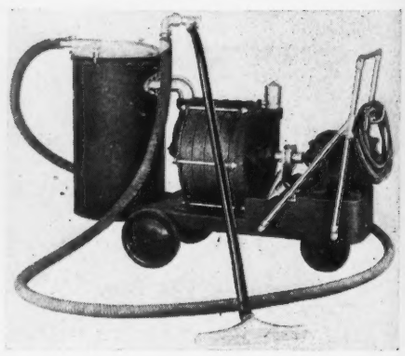
Truck

The "Universal" barrel truck is said to provide speedy handling of kegs, barrels, and drums with a high degree of safety. Contour of handle provides for operator to lean body against load when starting and stopping, and the load is discharged without releasing grip on the handle. This makes for minimum strain on the operator. Has overall width of 23 in. Height limits range from a 24-in. keg to a 40-in. drum. Ten-inch diameter wheels are used, either pressed steel, solid rubber, or four-ply pneumatic. Universal Truck Co., 1140 West Broadway, Long Beach, Calif.

Sweat-On Paste

This paste is for use in producing a wear-, heat-, and corrosion-resistant overlay or hard facing. It is spread over the surface, then sweated into the surface with torch or carbon arc flame, or by furnace heat. Colmonoy, Inc., Los Nietos, Calif.

Vacuum Cleaner



Heavy duty, light-weight, portable vacuum cleaner has vacuum producer with two outwardly mounted bearings and directly connected to motor through flexible coupling. Is substantially constructed and compact in design. Overall dimensions: length, 55 in.; width, 22 in.; height, 36 in. Two fixed and one swivel-mounted rubber-tired wheels. Compartment on base for carrying cleaning nozzles. Motor is $1\frac{1}{2}$-hp. United States Hoffman Machinery Corp., 105 Fourth Ave., New York.

U. S. Rubber Transmission Belts

Large and small—odd sizes, and those easy to fit—U. S. Rubber "tailors" a belt for every type of drive.

Looking around oil fields, mills, and factories, you'll see U. S. Transmission Belts doing big and little jobs *well.* For instance: Operating under severe dust conditions in a cement plant, a U. S. Rainbow Transmission Belt has given perfect service for 13 years . . . this is the same Rainbow brand that for 40 years has been meeting requirements of every conceivable type of drive . . . a brand unmatched for sustained performance.

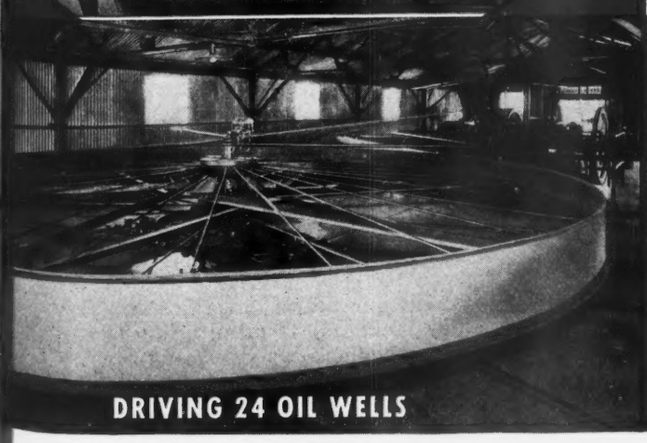
In a western mine, a U. S. Royal Transmission Belt has been driving a centralized water pumping system 24 hours a day for more than three years! It has put in over a million miles around the pulleys . . . without a sign of wear.

On an oil field power drive in Texas, a U. S. Royal Cord Cut Edge Endless Belt 187′ x 24″ x 9-ply, pumps 24 wells. A cotton-oil mill is replacing leather belts with 10″ x 5-ply Royal Belting, which, due to its unusual strength and stamina, gives unusual service although practically running in a pile of cottonseed. On light machine drives there is no equal to U. S. Royal Jr. . . . a light, flexible, and elastic belt which permits the use of thick belts for the narrow widths customary to such transmission service, especially when frequent shifting is required.

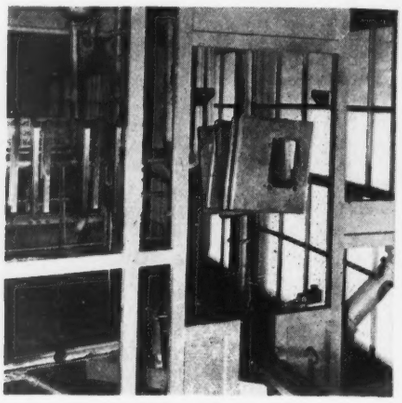
Get in touch with your nearest U. S. Rubber representative. You may save *dollars* in initial cost—operating cost—replacement cost. Let him *fit your job* with the *right U. S. Transmission Belt.* Write for "An Album of Familiar Belts," containing many interesting transmission, manufacturing, testing and application photographs.

United States Rubber Company

United States Rubber Products, Inc., New York, N. Y.



Operating Shorts

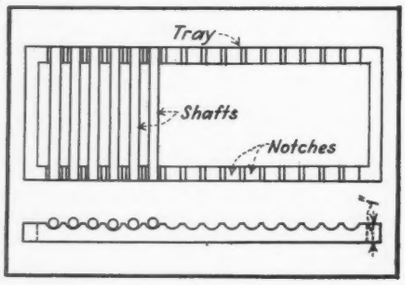


$350 Monthly Saving on This Handling Job

JACK WILKINS, *Royal Oak, Mich.*

A Detroit auto parts maker had been shipping to a local automobile manufacturer an average of 30,000 pieces of shafting, highly machined at both ends and requiring careful packing for shipment. These were packed in cardboard cartons, ten to a box, with pads and partitions to keep machined surfaces from contacting.

It was costing $325 per month for boxes plus $75 for packing. The cartons had to be trucked to the shipping platform, handled singly



onto trucks, and at the manufacturer's plant the boxes again had to be handled from road truck to a stock platform.

It was decided to put into service 15 large skid stock boxes 48 in. long, 42 in. wide, and 28 in. deep, equipped with stacked wooden trays. The sides of each tray were notched, with the notches spaced on 2-in. centers and the shafts laid crosswise on the tray, resting in the notches. As each tray was filled another was set on top and filled in the same manner until the box was full. A paper cover was then placed over the parts and a metal band strapped lengthwise over the box to hold the shafts securely in place during transportation. The cost of this equipment was $475.

Each box held 750 shafts, equivalent to 75 cartons, so that with a daily average of 1,500 pieces two boxes were packed, delivered to the shipping platform with a lift truck, and placed directly on the road truck. The manufacturer removed the boxes in the same manner, trucking them directly to his production line. The number of boxes placed in service provided an ample supply for "in transit" and process work at both plants.

The result: the cartons have been eliminated, the packing is done in half the time, and the handling of boxes at both ends has been eliminated. Only added expense is the return freight on the empty stock boxes and trays, which amount the manufacturer gladly pays in return for his lessened handling. Net savings to the parts maker amount to an average of $350 per month, and everyone is helped, including the trucking company. Where previously it required an hour to load the boxes and another hour to unload, due to the handling necessary, the trucks are now loaded and unloaded in one-tenth of that time.

Mr. Wilkins' contribution has been awarded the $10 payment offered by the editors for the best Operating Short submitted during the past month.

Baby bonus of a $10 savings bank account for each new arrival in employees' families is new policy of Stearns Magnetic Manufacturing Company, Milwaukee. Twins get a joint $25 account.

It Stops Conveyor If Work Is Too Large

THOMAS KEEFER, *Head of Factory Layout, The National Cash Register Company, Dayton, Ohio*

To stop the plating conveyor when racked work not within range of the degreasing tank passes, this photoelectric control was installed. But for this automatic check on size of the work going to the tank, serious damage to equipment would probably occur.

The path of light covers both sides and bottom of the opening. In the upper left-hand corner is the light source, and the path of light moves down the left side, is reflected by mirrors across the bottom and up the right-hand side to the photoelectric cell in the upper right corner.

Dust and dirt allowed to accumulate on reflecting surfaces of lighting equipment may decrease light output 15 to 25 per cent. Wipe reflectors and lamp bulbs frequently.

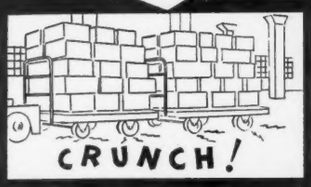
Electrically Heated Floors Keep Work Areas Warm

Douglas Aircraft Company solved an intricate heating problem at its Santa Monica, Calif., plant with an electric heating system built integral with the concrete floor.

Thus no usable space in the 300x 300-ft. hangar is taken up by heating equipment, yet comfortable working conditions are attained at floor level with minimum loss of heat through the hangar roof 85 ft. overhead.

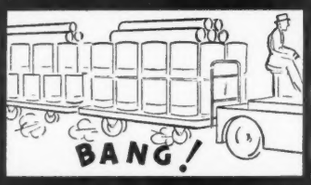
Main problems were to provide a low-cost system, eliminate fire hazard, provide comfortable working

HERE'S WHAT HAPPENS *with* STEEL-WHEELED TRUCKS *and* TRAILERS

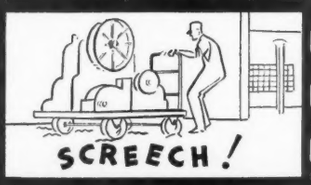


DAMAGED FLOORS

DAMAGED EQUIPMENT



LOAD BREAKAGE



SLIPPAGE—POWER LOSS

NERVE-WRACKING NOISE

HERE'S HOW YOU SAVE FLOORS·POWER·EQUIPMENT

Clatter! Clang! Bang! Your ears warn you of waste as steel hammers on factory floors. Chipping concrete, splintering wood —steel does serious damage to floors—wastes money and time that Goodrich rubber-tired wheels can save.

Inside trucks roll faster, easier, quieter on rubber-tired wheels. Rubber absorbs the shock of heavy loads, cuts floor maintenance costs almost to nothing.

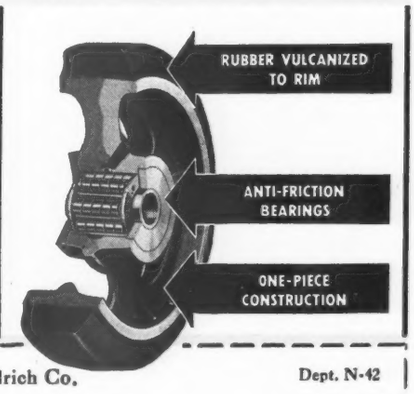
And that's only the first saving. Plant managers *with an ear for waste* find that Goodrich rubber-tired wheels cut power costs on tractor-trucks. That men do more work per day and use less energy on hand trucks. That equipment lasts longer and gives better service.

START SAVING NOW

Stop waste in your plant now. Discard obsolete steel wheels. Change to modern Goodrich Vulc-On Wheels and start saving. These complete one-piece wheels are vulcanized to the rubber tires. They're durable, inexpensive and trouble-proof. We have sizes for practically any truck, tractor or trailer.

Have a Goodrich engineer give you a complete estimate of costs and savings. Have him call today—or mail the coupon for information.

This Goodrich Vulc-On Wheel Pays Its Own Way



Goodrich *Industrial* Tires

The B. F. Goodrich Co. Dept. N-42
Akron, Ohio

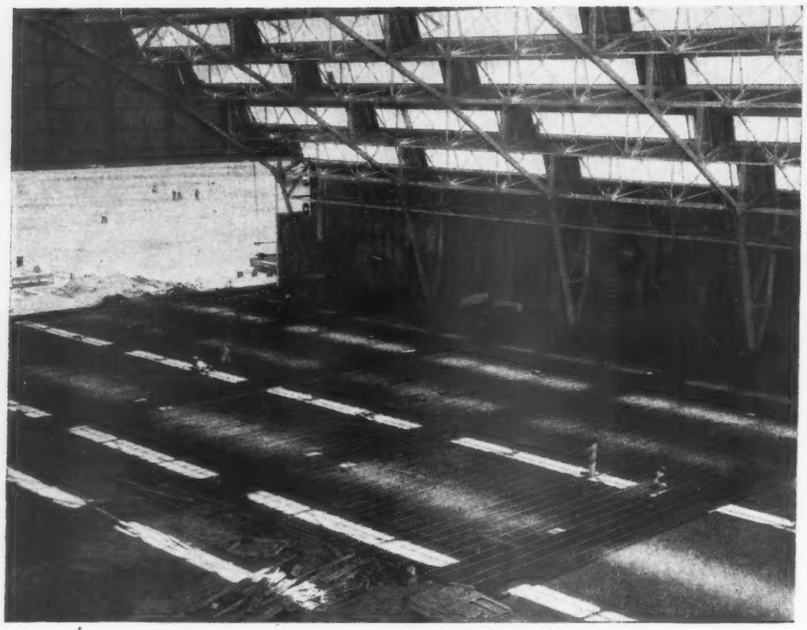
Gentlemen: Please mail me (without obligation) your booklet on Goodrich Industrial Tires and information on how they pay for themselves.

Name _____

Company _____

Street _____

City and State _____



conditions on the large floor space, and provide efficient, even heating of the big air space.

To solve these, Douglas engineers worked out the design which specified 53,000 ft. of single wire, laid within the concrete floor. The heating element, resistance wire, is contained in ¾-in. galvanized conduit. The conduit is filled with transformer oil and insulated with 1-in. porcelain tubes. It is laid in loops, each approximately 300 ft. long, with the conduit spaced about 2 ft. apart.

Energy at 230 or 460 volts per element is supplied through 12 thermostatic controls to the 12 sections of wiring. Peak load limiting equipment prevents the heating system from raising the maximum demand of the plant, thus cutting power costs.

Designed for a temperature rise of 12 deg. F., the system effects a floor temperature of 80 deg. during average winter weather. During extreme cold spells and at times when the hangar doors were opened for extended periods, floor temperatures fell noticeably below this figure.

At first, some sweating occurred, especially in places where the concrete floor lay over ground that had been filled and wetted. But as the earth dried out, sweating ceased.

Contributing to low-cost operation is the heat storage capacity of the concrete and earth. This permits the system to operate as an off-peak load, thus consuming energy at a low rate per kilowatt-hour. Operation is automatic. The stored heat is gradually given up by the floor, keeping tools and materials warm as well as providing comfortable working conditions.

Although Los Angeles weather is not extremely cold, this winter was one of the coldest on record. Throughout this period the system performed to satisfaction, keeping costs down and requiring no special attention.

If shafting and motors of a group drive seem unsightly, place them in a concrete trench below the floor.

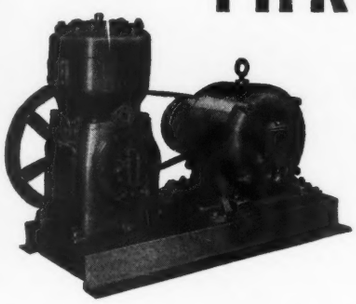
Special Notice

$10 will be paid for the best Operating Short submitted during the month of July. The Editors are the judges. Other Shorts accepted will be paid for at attractive rates

Tweet! Tweet! Here Comes the Sandwich Man

SOURCE, *General Motors Truck & Coach Pontiac, Mich.*

As is common in large plants, employees of General Motors Truck & Coach are served by vendors who wheel their carts through the plant with pie, sandwiches, candy, coffee, and milk for sale for luncheon. There is, however, one important difference. These vendors are equipped with whistles—just plain dime-store whistles of shrill pitch. When the lunch man has finished selling at one point, he begins tooting on his whistle as he starts down the aisle toward his next station. By the time he gets there, his customers are ready for



THRIFTY BUYERS
are QUICK to UTILIZE QUINCY SAVINGS

QUINCY FEATURES

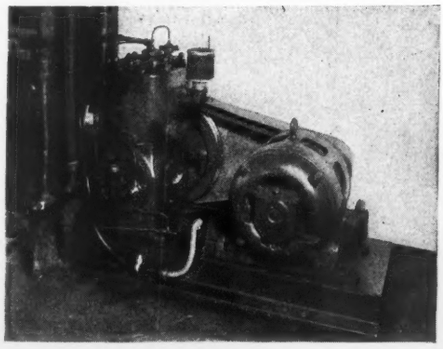
Timken Roller Bearings ● Semi-Steel Pistons ● Balanced Drop-Forged Crankshaft ● Non-Breakable Steel Valves ● Perfect Circle Piston Rings ● Lynite Connecting Rods ● Positive Full-Pressure Lubrication ● Improved Cooling ● Nickel Chrome Castings ● Dust-Proof Enclosed Crankcase.

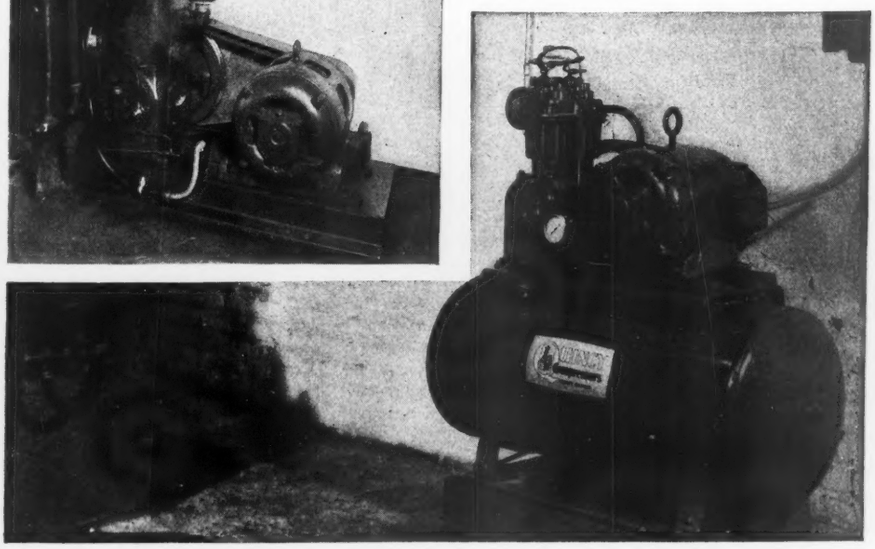
A first cost that is right and a long service life of dependable and economical performance combine to win, for Quincy Compressors, the favor of those men whose job it is to keep spending "down" and production returns "up."

Quincy Compressors are distinguished compressors. Their many automotive-type features give them exceptional staying qualities under long, hard service and enable them to deliver more air at less cost.

The fact that Quincy Compressors are the preferred equipment of a steadily growing list of discriminating engineers is deeply significant.

May we send you the data which justifies so many industrial engineers in deciding to "Install a Quincy?"





Quincy Compressor Co.
Quincy, Illinois

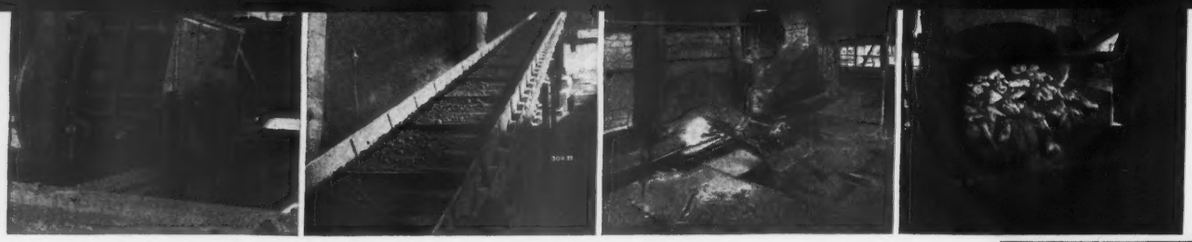
Branches: Chicago and New York

The Reynolds Engineering Company of Rock Island, Illinois, employ a Quincy Compressor (inset above) for central air supply, with twenty hoses for cleaning dies, operating pneumatic tools, etc.

The Fromson & Davis Co., Cleveland, Ohio, profit by using this Quincy Compressor Model HA-16 for dehydrating the air in its beef storage room in order to eliminate discoloration and loss of weight.

WHERE AIR IS IMPORTANT

QUINCY Compressors



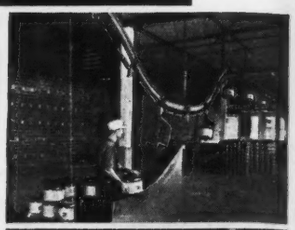
● Jeffrey crushers, pulverizers and shredders are available in types for reducing many kinds of material. Also double roll crushers, coke sizers, core crushers, sewage screenings grinders and garbage grinders.

● Jeffrey steel apron conveyors for handling hot or gritty material. Overlapping double beaded flights form continuous trough. Practically no waste or leakage.

● Jeffrey-Traylor electric vibrating conveyors, feeders, coolers, dryers, screens and barrel packers depend upon high frequency electrical vibration. Provide positive control over tonnage. A J-T water-jacketed tubular feeder and a J-T electric vibrating pan feeder are illustrated. Patented and Patents Pending.

● Also chains, attachments and transmission machinery, V-bucket conveyors, portable loaders and conveyors, bag stackers, barrel and tray-arm elevators, special store-room and car loading and unloading conveyors, skip hoists, mono-veyor systems, weigh larries, steel mill chains and conveyors, etc. All have their specific place in industry.

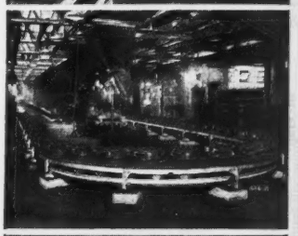
● Jeffrey trolley conveyors have a broad application in the service of production and assembly. The most flexible of all conveyors, going up and down, around curves, from operation to operation, building to building.



● Jeffrey belt conveyors are available in various widths and speeds . . . any length. Provide a continuous, uninterrupted flow. Hundreds of miles of these conveyors are serving industry today.

● Jeffrey wood apron conveyors are used extensively for progressive assembly lines and for carrying light and heavy packages, bales, barrels, etc., on horizontal or incline. Special flights for special conditions.

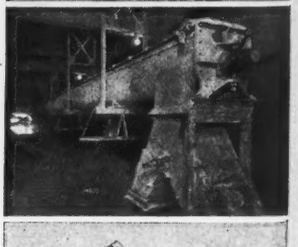
● Jeffrey Foundry equipment includes: continuous mold conveyors (illustrated) sandi-tioners, aerators, flask fillers, screens, fans, crushers and sand handling equipment. Complete systems or small installations in both large and small foundries.



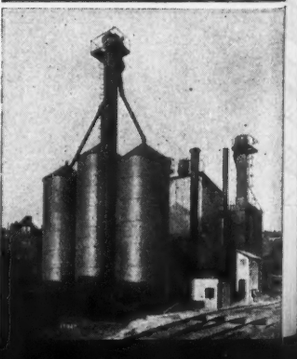
● Jeffrey scraper conveyors are used for handling coal in the boiler house. Also used for handling such material as chips, tomatoes, corn, lime, bark, ice, garbage, etc. Single or double strand chain.

● Jeffrey pivoted bucket carriers are foolproof, having sturdy malleable buckets, glass hard chain bushings, rugged construction thruout. Overlapping lips of buckets form a continuous conveyor. Can be used either in vertical or horizontal direction.

● Jeffrey spiral conveyors come in six types—used in moving such material as coal, soda ash, cement, powdered clay and grain. Very compact—no return flight needed. Can be made dust-proof.



● Jeffrey bucket elevators have won high regard in all industries. A complete line of standards have been worked out to simplify the selection.



Jeffrey SERVES ALL INDUSTRY

● From sugar beets to steel ingots . . . from coal mines to soup canneries . . . it little matters what branch of industry you select . . . Jeffrey has probably developed and installed material handling and reduction equipment to serve it.

Steel plants, mines and retail coal yards; food processing and meat packing plants; automotive, radio and metal working plants; foundries, quarries, glass and ceramic plants; sewage treatment and water purification plants; power plants and engineering projects . . . the list runs on and on through industry, commerce and public service.

For 60 years Jeffrey has accumulated knowledge by doing. The length and breadth of this experience makes Jeffrey a reliable source of cost reduction information . . . which can be applied to improve material handling and reduction methods.

Jeffrey stands ready to place this rich experience at your disposal.

1877 60 Years 1937

THE JEFFREY MANUFACTURING COMPANY
911-99 North Fourth Street, Columbus, Ohio
Sales Offices in Principal Cities

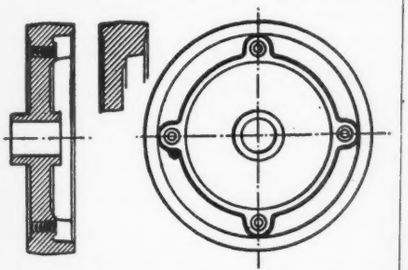
him. The plan is unimportant as saving the vendor's time. It is, however, of great value in keeping the men at work, making unnecessary their running to the aisle to see whether he is there, lest he be missed. The shrill whistle can be clearly heard above all the factory noises.

Ladders like to skid, so it's always good practice to put rubber, spike, or other type of non-slip feet on them.

New Drive for Looms Ups Output, Improves Quality

One of the problems in driving looms arises from the fact that these machines constitute a highly varying load. The picker hits the shuttle once during each revolution of the loom pulley. This contact occurs for a small fraction of one revolution, but during that period the load is many times its normal value over the remainder of the revolution. When a loom is belt-operated this sudden shock load causes the belt to stretch slightly; when the load is relieved the belt contracts, causing an uneven supply of power. With a motor-operated loom the variation in load is transmitted through the gear and pinion, again making it difficult to get smooth operation.

Study of this problem has led to the development by the Power Trans-



mission Council, Inc., Boston, Mass., of what is termed the Energy Drive. It consists of a flywheel pulley which is attached to the loom in place of the regular pulley, if the loom is belt-operated through a friction or clutch drive, or in place of the large gear if it is driven by an individual motor. With the new drive the loom must be driven through a friction device or clutch.

For a Draper X model loom the flywheel pulley, shown in the illustration, must be at least $14\frac{7}{8}$ in. in diameter and weigh at least 88 lb. The pulley for the E model and similar types of slow-speed looms must be $14\frac{7}{8}$ in. in diameter and weigh

PAGE FENCE

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. . . double thick—longer life
. . . at no extra cost!

PAGE—America's first woven wire fence—since 1883—offers another great advance in fencing—P-12 Galvanizing.

PAGE P-12 Galvanized Fencing, identified by the label shown above, is guaranteed to withstand a minimum of 12 one-minute dips by the Preece Test—the accepted method of determining galvanizing uniformity and resistance to corrosion.

The 12-dip guarantee is the highest known to the industry. Most former fabrics would withstand less than half this number of dips. PAGE P-12 Galvanizing applies not only to fence fabric, but to fittings, top rail and wing-channel line posts as well. Specify PAGE P-12 fencing for double-thick galvanizing, longer fence life—*at no extra cost.*

5 SUPERIOR FENCE METALS

Since various atmospheric conditions require especially resistant metals, PAGE FENCE is offered in 5 superior metals to meet every condition in fencing—Page P-12 Copper-bearing Steel, Page-Armco Ingot Iron, Page-Alcoa Aluminum, Page-Allegheny Stainless Steel and Page genuine Wrought Iron. Metal best for location impartially recommended.

92 Association Members

92 Page Fence Distributors with complete responsibility in fence erection and service, estimates and consultation are located conveniently throughout the United States—associated to serve you wherever you are.

FENCE FACTS FREE

Mail coupon below for nearest Page Fence Distributor's name and free copy of informative booklet, "Fence Facts."

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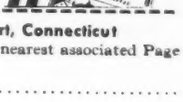

PAGE FENCE ASSOCIATION, Dept. F-7, Bridgeport, Connecticut

Please mail me new Free Booklet, "Fence Facts" and name of nearest associated Page Fence Distributor.

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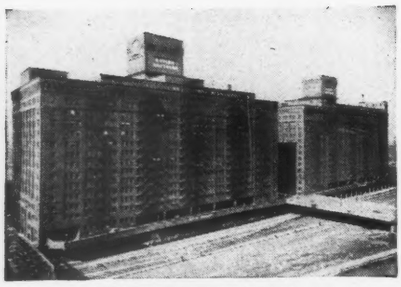


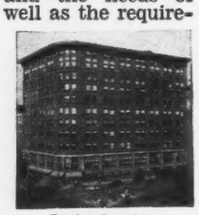
Butler Brothers, Chicago, Ill.

LEADING CHICAGO FIRM GETS IMPROVED HEATING

Famous Butler Brothers Complete Payment After One Season With Webster Moderator System

MEETS VARIED HEATING NEEDS

Chicago, Ill.—The heating installation in the great central warehouse and office building group of Butler Brothers Store was modernized during the early fall of 1935. The previously uncontrolled heating system was orificed throughout to balance distribution and placed under control of an 8-zone Webster EH Moderator System. This number of zones was necessary to provide for different conditions of occupancy and the needs of different tenants as well as the requirements of Butler Brothers own operations.



Butler Brothers
Baltimore, Md.

This modernization program, one of the largest central control heating installations ever made, was completed in a remarkably short time by William Lees, Inc., prominent Chicago heating contractors. The fall and winter of 1935-36 served as a period for adjustment and perfection of operating procedure.

An idea of the savings possibilities is afforded by the record for five months during this adjustment period, from January to May, 1936, inclusive. During this period a measured savings of 420.16 tons, equivalent to $1218.46, was attained.

Under the contract covering the modernization program Butler Brothers reserved the option to permit payment to be made out of current monthly savings as made, or to complete payment for cash. It is significant that with this privilege Butler Brothers elected to complete payment for cash early in the second season of operation.

It is even more significant that a similar modernization program has since been carried out in the Baltimore warehouse building of Butler Brothers.

These before-and-after facts point the way to maximum comfort and economy in heating new buildings as well as in modernization of existing installations. Consult your architect, engineer or heating contractor. Or address

WARREN WEBSTER & CO., Camden, N. J.
Pioneers of the Vacuum System of Steam Heating
Representatives in 60 principal U.S. Cities—Est. 1888

about 100 lb. It is a duplicate of the regular pulleys employed with friction drive, except that it has the diameter given above and has a 3-in. iron rim built into it. For broad looms (over 50 in.), the flywheel pulley should be larger.

The function of the Energy Drive is, of course, to provide a source of energy which may be called upon at the moment the picker hits the shuttle, thus relieving the transmission equipment of the sudden shock load.

Tests have shown that the speed of X model looms, group driven, could be increased from 180 to 193 picks per minute by use of the Energy Drive. Other advantages are elimination of the "bump" formerly noticeable in the lay when the loom is running, and reduction in the percentage of seconds.

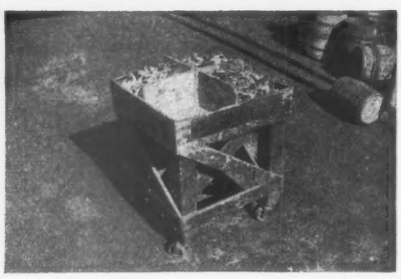
Ample stocks of spare parts and equipment are nothing more or less than breakdown insurance.

Partitions for Trucks Save Space and Investment

HENRY ALSTON, *Methods Department*
The American Fork & Hoe Company
Charleston, W. Va.

One division of our plant uses small square trucks to convey work from one operation to another. These trucks are about waist high with a bed 30 in. square and 8 in. deep.

At each operation where these trucks are used, the cycle consisted of removing a tool from one truck, performing the operation, and replacing the tool in another truck. The second truck was needed to keep



the finished work of each operation from becoming mixed with unfinished work.

With increased production the necessity for more trucks arose. But instead of buying additional trucks at $25 apiece, each truck was provided with a partition that gave the truck bed four pockets.

Now, when the trucks are first

There is practically nothing to wear on a Fairbanks Hand Truck that cannot be replaced easily and cheaply.

To prevent wear and provide added strength and rigidity, both the front and back are steel strapped. The electrically welded nose iron, which fits over the handle straps, can be replaced by removing only 6 bolts.

The channel-shaped, pressed-steel crossbars are set flush into the top of the wooden frame and rigidly bolted, eliminating weakening mortises. Handles, being part of the frame, cannot become loose.

All parts are strongly bolted together and lock washers are used throughout.

These and other vital features make Fairbanks Hand Trucks practically everlasting.

Fairbanks Trucks can be equipped with rubber-tired wheels to eliminate noise, prolong the life of the truck and protect floors from wear.

No matter what type of hand truck, platform truck, or push cart you desire, you will find it in our large catalog No. 950-5. Write for a free copy today.

THE FAIRBANKS CO.

Hand Trucks, Wheelbarrows, Valves and Dart Unions

401 Lafayette St. New York, N. Y.

Boston, Pittsburgh — Distributors in principal cities
Factories: Binghamton, N. Y. Rome, Ga.

Fairbanks
HAND, PLATFORM and BOX TRUCKS

CEILING PULL SWITCHES

This line of heavy-duty switches gives stalwart service in modern industrial installations. Designed with extra-heavy parts for a long life of extra-hard use. New back-wired type, (upper left), provides for easier wiring. Just connect wires to contacts on back of base and fasten the cover. This switch, No. 5020-BW, has outlet box cover for conduit work.

No. 3731 (upper right) is a 20 Ampere switch for Type C lamps. Regularly furnished with Bakelite switch cover.

No. 6650 (lower left) has slots in the porcelain base, for open wiring. No. 5020 (lower right) is same as No. 5020-BW except as designed for top wiring instead of back wiring.

Outlet box covers can be supplied in $3\frac{1}{4}$" or 4" size with all ARROW Ceiling Pull Switches. Above switches can be supplied in Wall Pull type with a side cord outlet. Write us for *complete listings.*

ARROW ELECTRIC DIVISION
THE ARROW-HART & HEGEMAN ELECTRIC CO. HARTFORD, CONN.

● There's safety for your men on walks of Steelcrete Expanded Metal. It is a diamond mesh with the strength of solid steel, non-skid, self-cleaning and offers no obstruction to light. This Steelcrete fabric is expanded from ¼" plate with 2" x 6" diamonds; supplied in widths of 16¼", 24¼" and 48¼"—plain, painted or hot galvanized. Send measurements for complete estimate covering all materials including angle supports, railings, etc. The installation of Steelcrete cat walks is simple, the cost is low, and there is practically no maintenance.

A FULLY ILLUSTRATED CATALOG will be sent you on request, showing the application of Steelcrete Expanded Metal Fence to all types of commercial fence enclosures.

THE CONSOLIDATED EXPANDED METAL COMPANIES
WHEELING, WEST VIRGINIA
Branch Offices and Warehouses
New York • Chicago • Cincinnati • Cleveland • Pittsburgh • Philadelphia • Boston • Buffalo • Houston • Atlanta
Export Office 330 West 42nd St., New York, N. Y.

loaded with work, three of the pockets are filled and one left empty. This permits the work to be handled at each operation with only one truck, as there is always an empty pocket to receive finished parts, thereby preventing mixing finished and unfinished work.

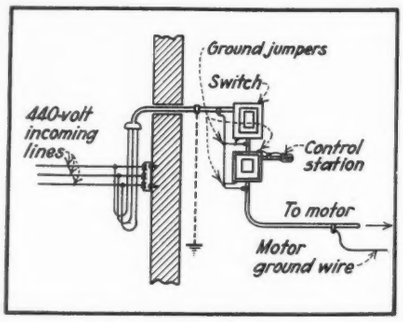
Not only did these 50-cent partitions eliminate the purchase of many trucks at a substantial cost, but it also increased the departmental truck capacity.

One estimate says that 15 to 25 per cent of all industrial accidents are due to poor lighting. Light up.

Improper Grounding Almost Causes Fatality

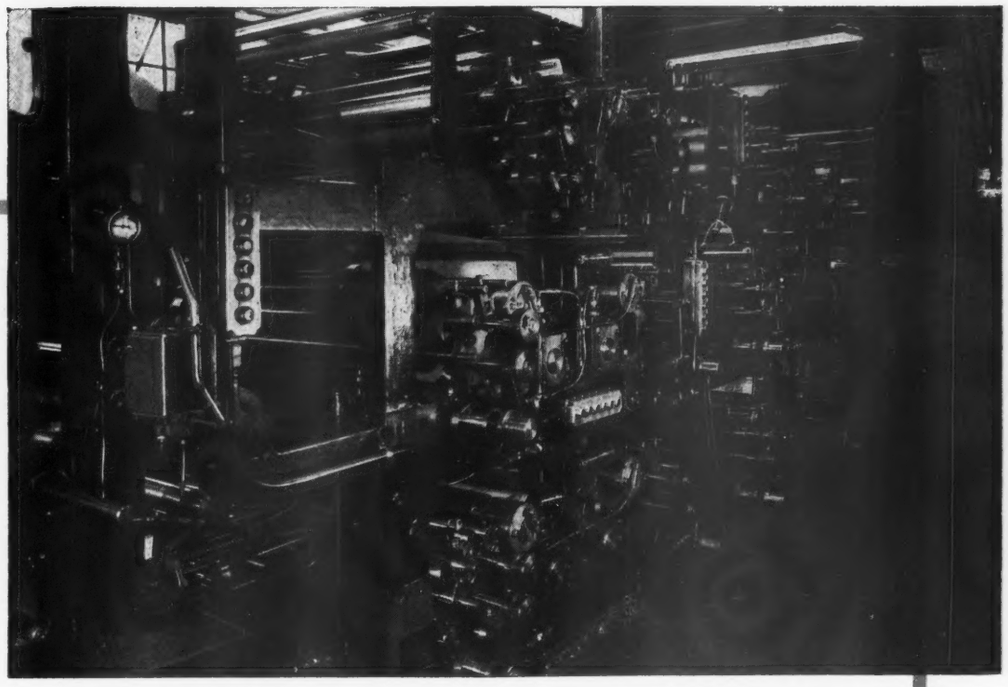
S. H. COLEMAN, *Roanoke, Va.*

Improperly grounded electrical equipment is a potential accident hazard. It is especially dangerous where grounding is assumed to have been correctly done, while in reality a very high resistance exists in the ground circuit or the circuit has been broken and no ground exists at all. The false sense of security engendered by such a condition was recently responsible for a very nearly



fatal accident in one large plant. This failure is all the more disturbing in that it occurred in a plant whose management is exceptionally safety minded and goes to great expense to eliminate any possible sources of injuries or fatalities.

The operator who very nearly lost his life touched the metal casing of a motor disconnecting switch. A subsequent investigation revealed that due to defective insulation one wire of the incoming 440-volt line was in contact with the switchbox. As shown in the sketch, the motor frame, conduit, and shielding of starting equipment were apparently amply protected by ground jumpers according to the standard practice



IMAGINE STOPPING A NEWSPAPER PRESS TO *"Oil Around!"*

There is no place for hit-or-miss greasing or oiling in modern, high-speed printing plants. Presses must not be stopped—neither can they be properly lubricated manually "on the fly." But with the Farval Centralized System of Lubrication, every bearing on the press is adequately supplied *at all times*—no matter how long the "run."

The Farval Centralized System of Lubrication is a mechanical method of delivering clean lubricant from a central station under high pressure to a group of bearings, in exact, measured quantities. Operation is constant and positive, regardless of the number of bearings in the system, *and not a bearing is missed.*

Manufacturers and owners of Printing Presses and similar equipment are cordially invited to inquire about the correct type of Farval System for their particular needs. The Farval Corporation, 3256 East 80th Street, Cleveland, Ohio.

Affiliate of The Cleveland Worm & Gear Co., Cleveland, Manufacturers of automotive and industrial worm gearing.

FARVAL

CENTRALIZED SYSTEMS OF LUBRICATION

Special Delivery to Every Bearing

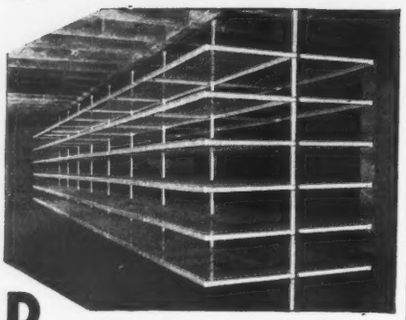
TOUGH ENOUGH FOR THIS

No towel can earn its keep that isn't tough enough to stand up under the mauling of hard-working hands. Yet this quality must be achieved at no sacrifice either in proper size or absorbency. Because Onliwon Towels combine these three essentials in such perfect balance, they have a unique record for downright economy in actual use. Phone your local A.P.W. representative today and let him show you with facts and figures how Onliwon Towels can bring to your washrooms added protection to health with increased economy as well. Or, write for samples to: A.P.W. Paper Company, Albany, N. Y.

A.P.W.

Onliwon Towels

SUPERIOR *Ventilated* RACKS



Reduce your material handling costs

If your present problem is space—if you're looking for storage, stock or portable racks that allow maximum efficiency in material handling the Superior Ventilated rack will meet your demands.

Designed by storage engineers, shelves are woven of heavy mesh permitting complete ventilation—increased light—no dirt accumulation and maximum efficiency of sprinkler system. Center post and open end construction allows access to material from any direction—permits unbroken shelf expanse. Each shelf is readily adjusted to any position giving complete flexibility for changing storage and production needs. Superior Racks available in any size (to your specifications) — permanent, portable or Mono-Rail

Write for complete information.

SUPERIOR WIRE AND IRON PROD.
1050 E. 76th St. Chicago, Illinois

followed in the plant. The electrician who installed the switch failed, however, to trace the continuity of the ground circuit. Had this been done, it could have been easily seen that the section of conduit passing through the wall was not grounded in any sense of the word. A ground such as indicated by the broken line in the diagram should have been provided.

Following this discovery, all ground circuits throughout the plant were checked and a surprising number of similar defects were uncovered and corrected.

•

52-Payment Plan Smooths Seasonal Employment

SOURCE, *Patterson Manufacturing Company, Dennison, Ohio*

One possible solution to industry's problem of providing for workers during seasonal layoffs is now in operation here.

This company manufactures automobile storage batteries, a product subject to seasonal production. The company has a closed shop and the union is affiliated with the A. F. of L. No labor trouble has ever been experienced, but due to seasonal employment the men and their families sometimes suffered financial embarrassment.

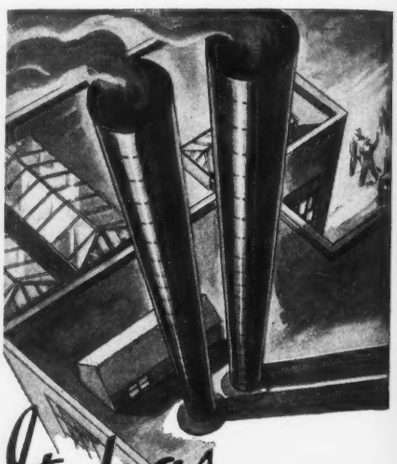
While the total income for the year was enough to meet living requirements, many of the men were not sufficiently provident to prepare for the "rainy days." As a result, when layoffs were necessary these men were forced to drift into other work and frequently did not return when called back to this plant.

To meet this problem our general manager called in the union representative and suggested that the annual income of the men be averaged on a 52-week basis, and this average be paid to them each week whether they worked or not.

The actual money received by each man over the annual period was to be exactly what he earns on his hourly rate, but he is assured of a fixed minimum each week. The offer was made to all employees who had been with the company for more than six months.

In return for these advances the men agreed as a body to guarantee the company against loss incurred by men leaving its employ while they were over-drawn. The amount of the overdraft is to be borne proportionately by the entire group.

This plan has apparently met with success. Since its inauguration there has been a marked increase



It has to be Good

An exposed industrial structure is no place for a mediocre paint. Sulphur-laden fumes, heat, rain, ice and dust work relentlessly in a wind-borne barrage of slow, yet unceasing destruction. To protect such a structure, a paint has to be good!

The minute, flat, overlapping flakes of natural graphite in Dixon's Industrial Silica-Graphite Paints form a shingle-like armor plating of chemically inert and inherently water-repellent pigment, hardened and toughened by the silicate particles which are by nature interlocked with the graphite flakes. This unique pigment is bound by pure boiled linseed oil, the best metal-paint vehicle known.

Dixon's Paints provide superior protection for eight, and even ten, years! The economy per square-foot year thus obtained eliminates differences in price-per-gallon.

You can choose from fourteen colors, including bright aluminum, and a line of special paints for meeting unusual conditions such as high temperatures. A card to Department BI 44 will bring you the details.

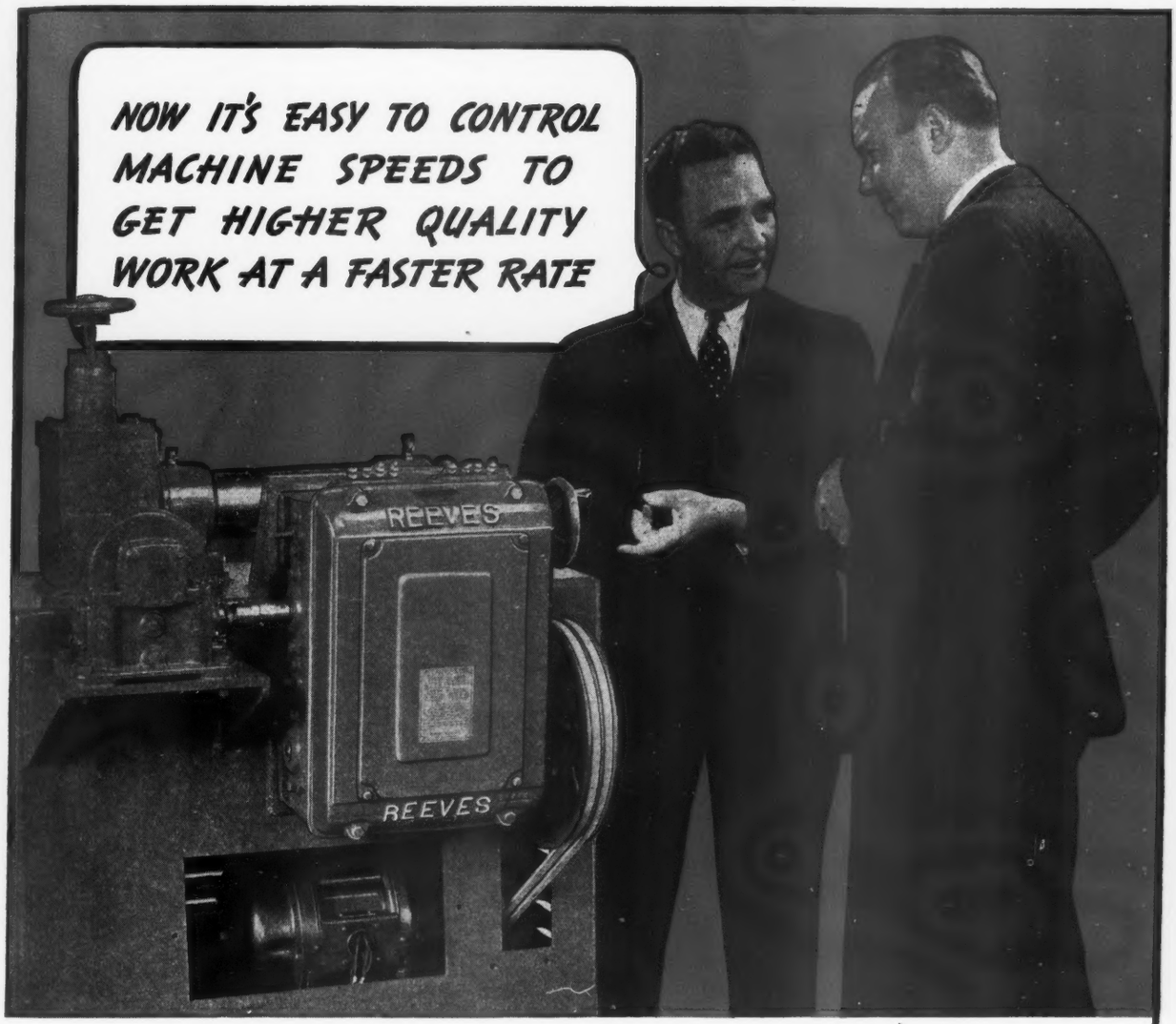
Paint Sales Division

JOSEPH DIXON CRUCIBLE CO.

Established 1827 — D X N TRADE MARK — Jersey City, N. J.

DIXON'S INDUSTRIAL SILICA-GRAPHITE PAINT

7448



THE word is passed along through the plant: "New REEVES installation . . . remarkable improvements in machine performance . . . production pepped up . . . work range widened . . . quality more uniform . . . operator more efficient . . ."

Comments like these are *inevitable* because results like these are *certain* when inflexible, inaccurately-speeded machines are given full advantages of infinite, accurate speed control as provided by the REEVES Variable Speed Transmission, Vari-Speed Motor Pulley or Vari-Speed Motodrive.

Perhaps your machines *are* "different." They may be designed for complicated, highly specialized work. But you will find that a brief talk with a REEVES engineer will simplify the problem of speed regulation and provide an economical, practical solution.

REEVES engineers are highly-trained men with years of experience in applying correct speed regulation to all types of machines in all industries. And they have the world's largest and most complete line of speed control equipment from which to fill your specific needs. . . . Get in touch with your nearest REEVES representative (in principal cities throughout the U. S.)—or write directly to our main office. Send coupon for your free copy of the most complete and authoritative book on speed control ever published.

REEVES SPEED CONTROL

REEVES PULLEY CO., COLUMBUS, IND.

Without obligation, please send me a free copy of your 118-page Speed Control Handbook—new edition.

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(F-7-37)

"Genius is the Infinite Capacity for Taking Pains"

DYNAMIC BALANCE

All Clarage fan and blower wheels—*every size*—are carefully balanced. First a static balance test—then a dynamic or running balance test. This assures smooth, quiet operation and freedom from destructive vibration—years of *extra* service!

ELECTRIC WELDING

is applied wherever practicable, both in the construction of wheels and housings. Rivets or bolts may loosen, but electric welding—a thorough job of it—combines the various parts into *one permanent structure.*

No stone has been left unturned to make Clarage Fans and Blowers the best that advanced engineering, highest grade materials and precision workmanship can achieve.

Furthermore, every moving part of every Clarage assembly is subjected to factory tests fully as strenuous as any ever encountered on the job.

These, in brief, are the reasons why engineers and users once experienced with Clarage equipment continue to specify it time after time, for every type of air handling and conditioning service.

Write us today about your present problem.

SPECIFY CLARAGE *for*

COMPLETE AIR CONDITIONING
VENTILATION
HEATING
COOLING
MECHANICAL DRAFT

FANS & BLOWERS FOR INDUSTRIAL NEEDS

CLARAGE FAN COMPANY - KALAMAZOO MICH.
Sales Engineering Offices In All Principal Cities

in cooperation among workers. Although no employee has left the company leaving a deficit to be shouldered by his fellow workers, there is every evidence that public opinion in the plant will frown vigorously on this practice.

The management feels that the investment required to make this payroll advance is a sound investment in man power. In the words of the general manager, "We feel that this plan involves no more than any seasonal industry owes to its men. It was not inaugurated with any altruistic notions, merely a hard-boiled business policy that improves our operations through relieving our men of financial worries and assuring the company a permanent, satisfied working force.

•

Public Address System Performs Important Duties

A public address system over which music, addresses, code calls, signals for starting and stopping work, and a watchman's call can be sent has been installed at the new radio tube plant of Hygrade Sylvania Corporation, Salem, Mass. It consists of the main amplifier unit, the code-calling device, a dual-speed phonograph which is built into the amplifier, and 32 dynamic speakers located at strategic points throughout the building.

The main amplifier is located in the dispensary and consists of a control panel with switches and volume control for radio, record, voice and code calls, and volume level indicator. At the rear of the panel is located the two-tube pre-amplifier, the mixer, and a one-tube oscillator for the start-and-stop, code-call, and watchman's signals.

Below this panel is a built-in phonograph, which has a crystal pickup and feeds three amplifiers located below it. Each amplifier has its own volume control and is capable of approximately 34 watts output. At the bottom is the two-tube power supply, which furnishes all the power for the amplifiers.

The speakers are the semi-high-fidelity, dynamic type with 12-in. diaphragm. They are mounted on an artificial board baffle 2 ft. square and 1½ in. thick, which is fastened in an angle-iron frame and suspended from the beams by beam clamps. Speaker fields are excited from a 150-volt d.c. generator which runs 24 hours a day and furnishes power for other purposes.

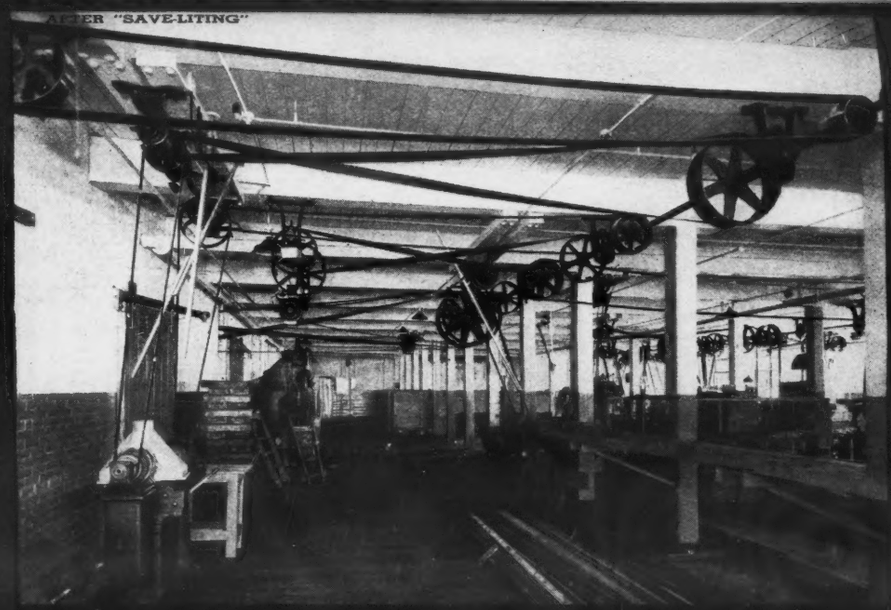
The code-call device was designed by the plant electrical department.

BEFORE "SAVE-LITING"

WHEN LIGHT IS POOR, EFFICIENCY SUFFERS

No help to productive efficiency are ceilings and walls when they become dark. They soak up valuable light . . . breed eye strain, fatigue . . . promote uncleanliness. SAVE-LITE is needed here.

AFTER "SAVE-LITING"



WHAT A DIFFERENCE SAVE-LITE MAKES!

Here at the Worcester Lawn Mower Company, Worcester, Mass., they paint ceilings and walls with Sherwin-Williams Save-Lite. It reflects more light . . . diffuses it more evenly . . . makes seeing and working easier, quicker.

SPECIAL FORMULATION fits SAVE-LITE to SPECIFIC JOBS!

There are too many difficult jobs interior paint must do in your plant for any single white paint to do them all—with economy!

That's why Save-Lite regular — the basic Sherwin-Williams Save-Lite — also comes in specially formulated types. These types offer various degrees of heat and fume resistance. Each type of Save-Lite does its specific job at the lowest possible cost. And that job is greater and more lasting whiteness, longer life under each special condition. Consult the Sherwin-Williams painting engineer for specifications.

FREE: This complete "Plant Conditioning" report. Every plant operator should have it. Write The Sherwin-Williams Company, Cleveland, Ohio and all principal cities.

SHERWIN-WILLIAMS SAVE-LITE

THE PLANT CONDITIONING PAINT

SEE THE SHERWIN-WILLIAMS PAINTING ENGINEER

Simplex

Push and Pull

Jack

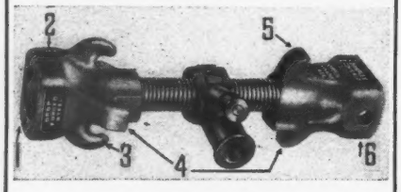
And Equipment

What it does:

It serves as a time and money saver on countless maintenance, repair and production jobs involving:

1—Pushing
2—Pulling
3—Straightening
4—Clamping
5—Lifting
6—Pulling Wheels

How it is used:



1 Insert any length of standard 1½" pipe in either or both well ends for PUSHING or SPREADING. Powerful—10 tons capacity. Ideal for close-quarter operations. Useful for hundreds of purposes.

2 Insert Sky Hooks here—chains attach to sky hooks—jack used this way for CENTERED PULLING. Handy, quick, powerful. Many needs for it every day—a good way for easy savings.

3 For attaching cable, wire, rope or chains. This feature is handy for STRAIGHTENING and WELDING work where pressure must be applied at an angle for straightening, or broken parts held in place for welding.

4 For SPREADING. Here again is a Simplex arrangement for certain spreading jobs. Plenty of power—does the work quickly. Saves costs every step of the way. SPREADING can also be done on the ends of the nuts.

5 For CLAMPING structural members or tensioning struts when welding broken pieces. (The other welding clamp is on opposite side of left hand nut in illustration.) Ideal for repair work on conveyors, elevators, chutes, rails, etc.

6 Attach 3-Way Base here. With the 3-Way Base attached, the Jack can be readily used for LIFTING or, with chains, for PULLING FLY WHEELS, PULLEYS, GEARS, etc., regardless of how far they are from end of shaft.

What it consists of:

1. No. 610 Simplex Special Push and Pull Jack.
2. Sky Hooks (2), drop forged steel, heat treated.
3. Three-Way Base (and wheel puller attachment) drop forged steel, heat treated.
4. No. 3-A Simplex Spreader Jack.
5. ½ inch x 40 inches Heat Treated Chains (3), fitted with drop forged grab hooks.
6. Drop forged, chisel pointed Lever Bar, heat treated ¾-inch round x 18 inches long.
7. Three Simplex No. 610-11 Stud Links, drop forged steel, heat treated.

Stocked by Leading Supply Houses

Templeton, Kenly & Co.
World's largest mfrs. of Lever & Screw Jacks for Industrial Use.
1020 So. Central Ave., Chicago

It is located at the telephone switchboard and has a capacity of 30 calls, which the operator selects on an ordinary telephone dial. The calling device will repeat calls twice or three times, as desired, before it automatically resets.

Current is kept on the amplifier 24 hours a day and the front door bell is connected to the system at all times. This arrangement makes it possible to summon the watchman at any time after working hours, regardless of where he may be in the building.

Signals for starting and stopping work are controlled by a program clock.

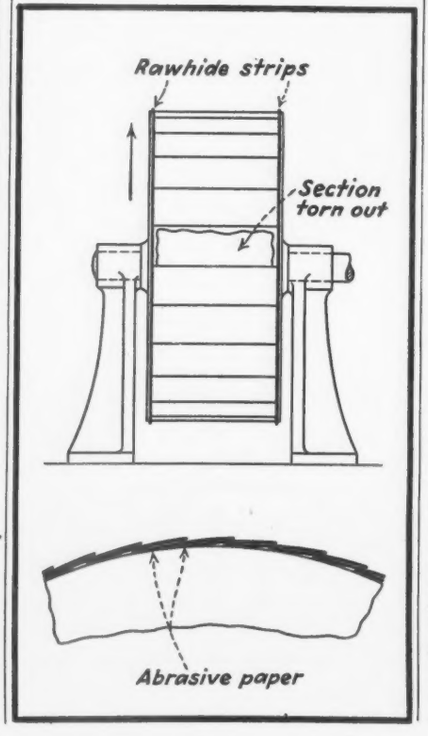
Tests have shown that noise cuts down workers' efficiency, so in operations where a great din is unavoidable ear stopples may be practical.

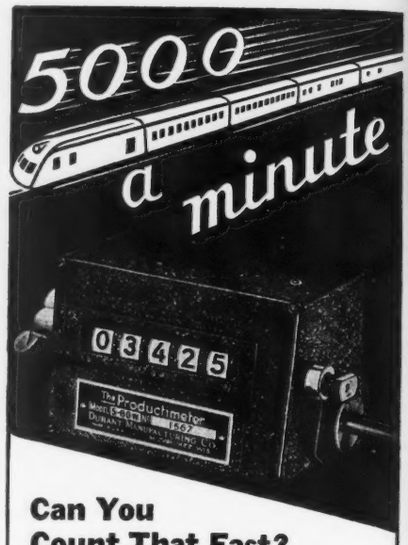
When the Paper Gets Dull, Tear It Off

L. KASPER, *Philadelphia*

A novel method of resurfacing a sanding drum is used in one shop, that results in a considerable saving of time.

Instead of covering the drum with a band of abrasive paper in the usual manner, a number of sheets of such paper, overlapping each other so that about 2 in. of each sheet re-





Can You Count That Fast?

Productimeter 5-BDW-7 above is our answer to the demand for reliable counting (up to 5000 rpm) on modern high speed machines.

Whatever you have to count or measure you will find a Productimeter enabling you to keep accurate production records day in and day out.

Productimeters
THE SPEEDOMETERS OF INDUSTRY

DURANT MFG. CO.
1918 N. Buffum St. Milwaukee, Wis.
176 Eddy St. Providence, R. I.

TELL US WHAT YOU WANT TO COUNT

How Much Does It Cost You To Keep The Plant Clean— Or Not To?

MAYBE you never thought that factory cleaning means a profit or a loss. That is true. Time out to learn what it *is* costing to clean—or not to clean—never failed to pay money returns.

There is nothing sentimental about the selection of Super Industrial Cleaners by the big factories where they are in daily use. Supers save payroll money—one man with a Super does more than a crew with brooms, brushes and rags. Supers increase production without increasing cost, because men and machines work better in clean plants. Supers prevent many occupational hazards arising from dust, for Supers capture poisonous dust wherever it may be—at point of origin on machines or elsewhere—before it can be breathed by workers. The Super is readily adaptable to many varied uses—every one saves your money. Try a Super at our risk. If you are not convinced returnable for full credit after a vigorous 3-day trial. All risks of damage to the Super are ours, not yours. Let us ship you one. See for yourself.

The National Super Service Co.
1945 N. 12th Street Toledo, Ohio
Suction Cleaner Specialists for Twenty-Seven Years

For a world of Industries

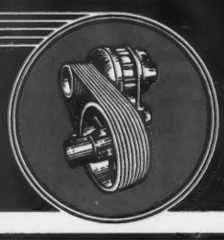
Texrope Drives

Wherever you are located or whatever your V-Belt drive requirements may be, apply to Texrope Division, Allis-Chalmers Mfg. Co., for we make V-Belt drives for every purpose and carry stocks in all principal cities of the United States and other parts of the World. • Allis-Chalmers originated, developed and pioneered the multiple V-Belt drive principle and regularly builds drives of from ¼ hp. to 2000 hp. However we are equipped to build larger drives where unusual conditions require them. • The wide range and length of experience that Allis-Chalmers has had in building multiple V-Belt drives far exceeds that of any other manufacturer in the industry, and that knowledge and experience is built into every Texrope V-Belt Drive. • Furthermore, the Allis-Chalmers Mfg. Co. offers unlimited assistance to users, dealers and original equipment manufacturers through maintaining a large staff of trained engineers in various districts for the purpose of helping in the field. • When you buy Texrope Drives you buy not only the most efficient performance, but also the quickest and most complete service. Before purchasing a multiple V-Belt drive consult multiple V-Belt headquarters—Texrope Division, Allis-Chalmers Mfg. Co.

Write for Duro Brace Bulletin 2188

TEXROPE DIVISION

ALLIS • CHALMERS



764

MILWAUKEE WISCONSIN

Air Handling

also saves time!

3 Ton MonoRail System installed in San Diego Plant, Consolidated Aircraft Corp.

Like traveling by plane, American MonoRail saves time by providing permanently smooth airlines for quick passage of loads over operating area.

With newly developed equipment, three ton capacities are easily handled through switches on precision ball bearing trolleys. Motor driven cranes and hoist carriers offer safe transportation of 5 ton loads at 200 feet per minute.

Specialized engineering experience is available, without obligation, to help solve your handling problems. A copy of the 192 page book "Overhead Material Handling Equipment" will be mailed on request.

• • •

AMERICAN MONORAIL CO.

13114 Athens Ave., Cleveland, O.

mains exposed, are put on. The sketch shows the arrangement of the sheets, although the effect is exaggerated for clarity. The sheets are glued together for about ½ in. along the two outer edges, and strips of rawhide are stretched tightly around the edges of the drum. The purpose of the strips is to hold the sheets firmly in place while the glue dries.

When the abrasive surfaces in use have become dull, it is merely necessary to tear out each exposed section, as shown, in order to present new, sharp surfaces. This procedure may be repeated a number of times before the drum must be recovered.

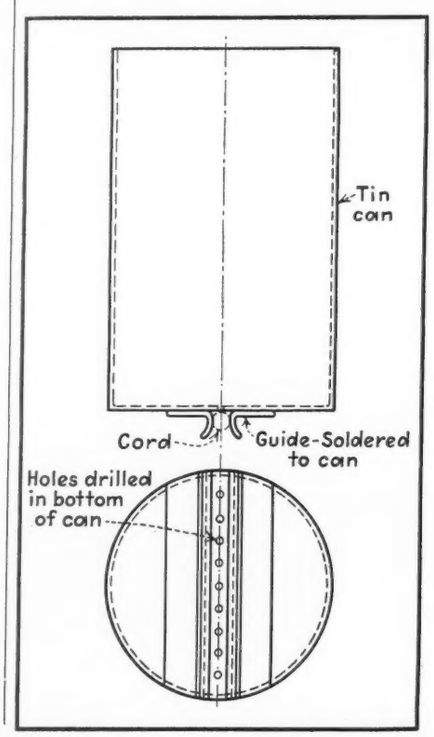
•

Line Chalker Made from Tin Can

HARRY SLADEN, *Philadelphia*

In a shop doing sheet metal work there was a job where a number of holes had to be punched in long sheets. These holes were for perforations only, and were laid out along a chalk line.

Since the biggest job in using a chalk line is keeping it chalked, it was necessary to devise some means to do the chalking quickly and easily. A tin can was rigged up with guides soldered to the bottom, and between these guides a series of holes was drilled across the can. The can was then filled with talcum powder or whiting. Running the can once or twice along the cord marking the line did a quick job of chalking it.



STICKING RINGS TOOK HIM FOR A RIDE

Read what happened when Shell men stepped in and tackled the problem . . . !

THE superintendent of the Diesel light plant in an Iowa town was fed up! Ring sticking caused by excessive carbon and other deposits was increasing maintenance costs —working his staff overtime!*

The Diesel was taken down—pistons pulled and rings examined. A complete survey of the lubrication system and lubricant was made—nothing was overlooked!

Then—and *only* then—did the Shell men make their recommendation! Shell Talpa Oils for Diesel lubrication—perfected by Shell, working with leading Diesel manufacturers!

Today the plant's records show the result: Production of kw.-hours steadily mounting. Consumption of lube oil markedly cut. And, according to the superintendent: "Our carbon and ring troubles are licked!"

Wherever there is a lubrication problem, the ingenuity and resourcefulness of Shell—backed by a progressive engineering staff—are available for your use. Phone or write your nearest Shell office.

*An actual case history from Shell's files

SHELL'S "INVISIBLE ELEMENT" is a combination of Shell's unmatched world-wide resources; Shell's modern laboratories and refineries; years of cumulative experience in research by Shell's engineers and scientists. It is the determination to make lubrication more efficient, more economical for you.

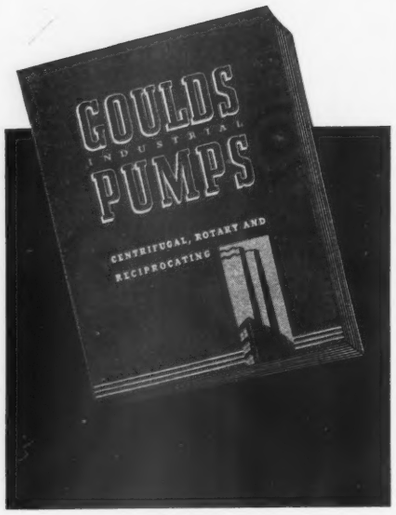
SHELL

SHELL INDUSTRIAL LUBRICANTS

GOULDS "CLOSE-COUPLD" CENTRIFUGAL PUMPS
Single and Two-Stage Enclosed Impeller Type
You should have this.. NEW PUMP BOOK Just off the press!

Whether you are a large user of pumps or just an occasional buyer, you should have a copy of Goulds New Industrial Pump Catalog. Eighty pages filled with complete and detailed information on centrifugal, reciprocating and rotary pumps for every application. Just the type of information you should have for selecting the right pump for the job.

You need this new catalog of the world's largest pump manufacturer. We'll mail it to you at once if you'll just send the coupon below.



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GENTLEMEN: SEND MY COPY OF THE NEW GOULDS INDUSTRIAL PUMP CATALOG AT ONCE.

CO. NAME_____ CITY_____

ST. ADDRESS_____ STATE_____

INDIVIDUAL_____ TITLE_____ E

7503

Typed Instruction Sheets Can Be Blueprinted

JOHN E. HYLER, *Peoria, Ill.*

It is sometimes desirable to type instructions on tracing paper in order that they may be blueprinted and copies sent into the shop. Specification sheets, work instruction sheets, machining instructions, and many other forms of data used from time to time may be filed away on tracing paper sheets of small size, say 9 x 12 in., and prints made as required.

Chief difficulty with this process has been that ordinary typed work is not sufficiently black to block off the light completely. Clear copies could not be produced, the prints being more or less blurry.

A method that we have found to give a clearcut and intensely black letter on the tracing paper is to sandwich the tracing paper between two pieces of carbon paper in such manner that the carbon is turned toward the tracing paper on both sides. Typing them transfers the carbon from both sheets to both sides of the tracing paper in exact registration, making the letters intensely black and highly resistant to light.

Burned out motor bearings became scarce in one plant when departmental employees ceased to make adjustments for belt tension and the electrician was assigned that responsibility.

Two Ways to Outwit Fatigue

FLOYD DAY, *Greenough, Mont.*

Manufacturers are continually confronted with the problem of fatigue in their employes. Here are two ways to outwit it:

1. When a man is hungry, he should eat.

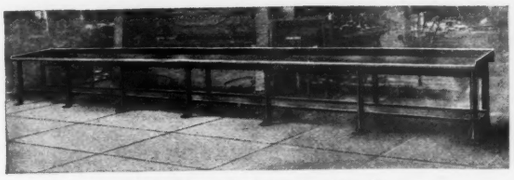
Two distinguished physiologists at Yale University, Dr. Howard W. Haggard and Dr. Leon A. Greenberg, after six years of studying industrial fatigue, have come to the conclusion that if you are in good health and not under doctors' orders, five meals a day will add to your energy and work efficiency.

A test was given to 40 shoeworkers. They were divided into two equal groups. One group ate three regular meals a day and averaged 183 shoes an hour. The

REPLACEMENTS WON'T WORRY YOU FOR A LONG TIME TO COME— CHOOSE

"HALLOWELL"

"HALLOWELL" Continuous Benches



Patented and Patents Pending

Fig. 722—"HALLOWELL" Continuous Work Benches of Steel are built up from standard sections to any length desired. Can also be dismantled and used as individual benches. Smooth tops of heavy steel can't splinter or burn; strong welded construction can't get wobbly. **Write for bulletin.**

"HALLOWELL" Steel Stools

Remember—comfortable workers do more. The one piece welded steel construction of "Hallowell" stools and chairs makes them last longer—another item when you're considering profits.

You can get just what you need in a "Hallowell" for the line is most extensive, with a design adapted for use at any type of operation. **Write us for our catalog.**

Fig. 1249
Pat. Applied For

"HALLOWELL" Steel Trucks

Fig. 754—"Hallowell" Steel trucks are made to withstand the toughest treatment. Their steel platform can't splinter—their welded construction assures permanently rigid joints. And, because their wheels have smooth bores or anti-friction bushings in hubs and casters, and are perfectly lubricated, they're much easier to handle. **Write for Bulletin.**

Patent Applied For

Type "H"

"HALLOWELL" Steel Lift Truck Platforms

Can't injure wood floors; steel platform — strong as they come — has hardwood legs. **Get Bulletin.**

"HALLOWELL" Steel Collars

Fig. 1432—These highly polished Collars cost less than cast iron Collars, yet are far superior. Made of Cold Rolled Steel, they positively won't crack—and set screw can't possibly strip the threads. **Write for Bulletin.**

Patented

STANDARD PRESSED STEEL CO.

BRANCHES BOSTON DETROIT INDIANAPOLIS

JENKINTOWN, PENNA.
BOX 546

BRANCHES CHICAGO ST. LOUIS SAN FRANCISCO

RHOADS TANNATE LEATHER BELTING

"Nothing Like Leather"
No Leather Like Tannate

Since the industrial revolution began, following the common use of the steam engine, an enormous number of materials have been tried for the mechanical transmission of power by belting. Among the first used of these was leather, followed by many types of fabric belting. Under the rigorous test of time, modern scientific developments of belting have improved as loads and speeds of machines increased. But for the great majority of industrial drives, and especially the severe ones, there is still "nothing like leather."

Other types of belting nearly always show a lower first cost than does Rhoads Tannate Belting, but the wide extent of its use in many of the most progressive industries indicates that many managers have found that it usually gives increased output, lower cost for operation, and longer service life than other types; in a word, lower cost per unit of output.

Usually first quality belts have one or more outstanding good points that justify their classification as "first quality belts." Few, indeed, have the **combination** of **outstanding qualities** required by the best engineering practice that are found in Rhoads Tannate Leather Belts.

These scientifically developed qualities combined in the Tannate give you dependable, long-life belt-service, with lower maintenance and replacement costs and possibilities of increased output, lowered unit cost of product and accompanying increase in profit.

J.E.Rhoads&Sons
PHILADELPHIA, 35 NORTH SIXTH ST.

NEW YORK 102 Beekman St.
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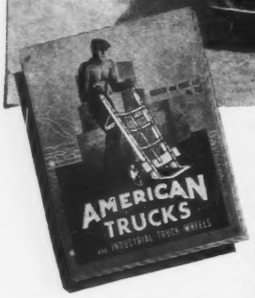
CHICAGO 26 N. Clinton St.
CLEVELAND 1200 W. Ninth St.

Factory and Tannery, Wilmington, Delaware

They just keep rolling along

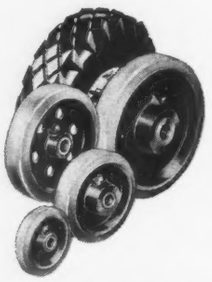


"They almost get up and go by themselves." That's what the fellows say who have to operate these trucks. Scientific balance gives them this quicker start . . . this ease in running that makes trucking payrolls more productive.

The cost of a hand truck is the smallest item in handling expense. A little money saved on the purchase price of an inferior truck is soon offset by repair bills and quicker replacements. American Pressed Steel Hand Trucks eliminate perishable wood by using light, strong, tough steel frames that roll on accurately turned, true-running wheels. Hundreds of concerns in every branch of industry have ended up 'way ahead of the game by replacing their truck fleets with "Americans" as needed.

Ask your dealer or write direct to us for the American Pressed Steel Hand Truck Catalog. You'll find models designed for every material handling need.

THE AMERICAN PULLEY COMPANY
4200 Wissahickon Ave. — Dept. 4 — Phila., Pa.



American Tested Rubber-Tired Industrial Truck Wheels
Our Hand Truck Catalog includes illustrations of every type of wheel used on these trucks with face and hub dimensions engineered accurately for load to be carried. Copy mailed on request.

AMERICAN
PRESSED STEEL
HAND TRUCKS

other group was given two extra meals—a glass of milk and a small piece of angel food cake at each extra meal—one in the forenoon and one in the afternoon. This group averaged 170 shoes an hour on three regular meals, but with the two extra meals their average jumped to 193.

2. Have regular rest periods.

The spinning department of a Pennsylvania textile mill had a 250-per cent labor turnover in a year; that is, 2½ workers filled each job there in a year. In other departments of the mill there was just a 5 per cent turnover. The workmen in the spinning department complained of neuritis, foot trouble, and melancholia.

Then the company established rest periods. For 10 minutes out of every 2 hours everybody was compelled to lie down flat and relax. As a result, production rose; complaints ceased; workmen earned bonuses; at the end of the first year there had been no labor turnover. Because every man liked his job, he stuck to it.

A test was run on workmen putting crossties on one of the largest railroads in the West. The average number of ties for each man was 12 a day. With rest periods of 5 minutes' duration each hour, with 5 meals a day, with milk at each meal, the average jumped to 18 ties per man.

•

Employees "Go on the Air" on Public Address System

ELLIS ROSENTHAL
Maiden Form Brassiere Co., Inc.
New York

About a year ago we installed a public address system throughout thirteen floors in our three buildings. With this equipment we have been able to play records at regular intervals during each working day, broadcasting interesting events such as the World Series, and make general announcements to all employees at one time. Results have been highly satisfactory in reducing monotony of repetitive work.

Recently, employees have been entertained with songs, music, and one-act plays, presented weekly during part of the lunch hour by various members of the company glee club and dramatic groups. These brief broadcasts have proved highly entertaining, and serve as a great source of satisfaction to all and a means of expression to those who take part.

IT'S UP HILL ALL THE WAY

WHEN WIRING CAN'T CARRY THE POWER LOAD

An out-of-date wiring system, with overloaded circuits can't bear the constant strain of extra burdens. Such wiring has an uphill job and is never capable of meeting the requirements of production increases . . . sooner or later it may bog down entirely.

Deficient wiring, with its heat losses and voltage drops, is expensive to repair and maintain — even more costly when overloads cause temporary standstills and production lags.

Have your wiring checked. If it can't carry the power load your plant requires, rewire for electrical efficiency, using G-E Wiring Materials. Get 100 per cent protection and permanent economies.

G-E Wiring Materials include: G-E White Rigid Conduit, Boxes and Fittings, "BX" Armored Cable, "Safecote" Building Wire, Service Entrance Cable, Fiberduct Underfloor Wiring Systems, and G-E Wiring Devices such as Switches, Convenience Outlets, Branch-circuit Circuit Breakers, Fuses, Plates, Plugs, etc.

For samples and information, see your nearest G-E Merchandise Distributor, or write to Section CDW-967, Appliance and Merchandise Department, General Electric Company, Bridgeport, Connecticut.

GENERAL ELECTRIC

WIRING MATERIALS

APPLIANCE AND MERCHANDISE DEPARTMENT, GENERAL ELECTRIC COMPANY, BRIDGEPORT, CONNECTICUT

Sayings and Doings

Aptitude Tests

I read with considerable interest the article appearing in June *Factory* entitled "Aptitude Tests Help You Hire." The general ideas covered have been in use for some time by the larger corporations, and considerable literature on this subject has appeared in the past few years. To the writer, it seems again to be one of the rather inhuman approaches to the whole problem of providing ways and means for finding employment for all the various grades and types of persons in the national labor picture, for whom there must in some way be provided at least a bare subsistence. We cannot laugh off the fact that although all persons may be created equal, their capabilities certainly are not equal when they reach the age where it becomes necessary to fend for themselves.

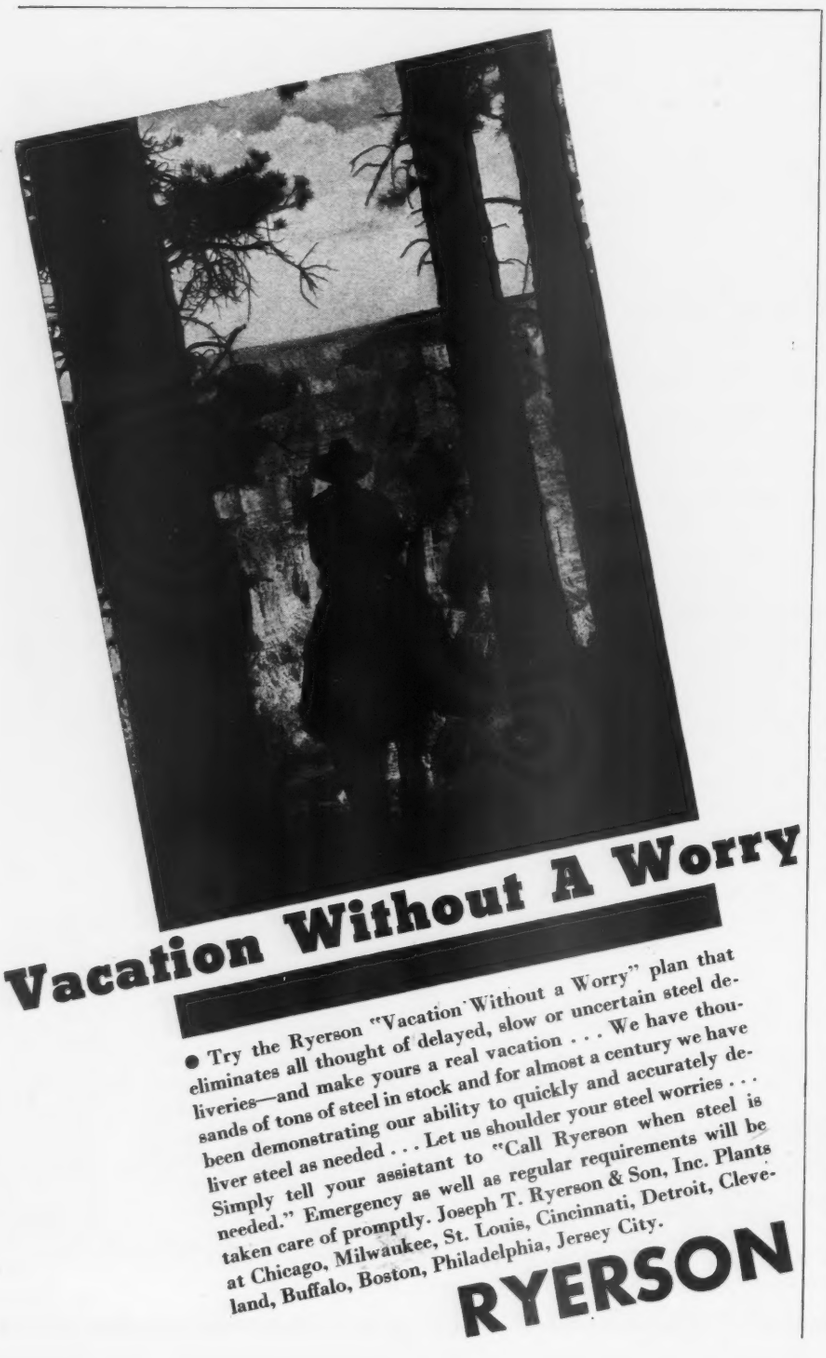
The larger corporations, with the funds available to make a thorough study of the best scientific means to test prospective employees, no doubt finally provide themselves with an employee group which will rank considerably above, in general intelligence and efficiency, the average employee group of the smaller companies, who do not have the necessary facilities to carry on this weeding out process. The result, therefore, is that the stronger companies find and retain only the cream of the available crop, while the less desirable applicants must either find work where the entrance tests are not so rigorous, or else find no work at all. These persons may then become public charges, must be supported by taxation, and thus the larger corporations must help by their tax payments to provide indirectly for the same people whom they would not employ directly, because of failure to come up to the so-called aptitude, intelligence, psychological, or what have you, tests.

I recently visited the factory of a large corporation where the weeding out process was carried to the ultimate degree. Applicants were first given a series of very complicated and severe aptitude tests at which only a few succeeded, but this was only a preliminary step. Next, the applicants who passed these tests spent a period of time in an instruction room where slow motion pictures were shown of the type of work to which it was proposed to assign them. Then they were put to work in an instruction and learning department, entirely separate from the regular production division, but which duplicated the most important operations in the plant on a small scale. The applicants then spent two weeks in this miniature production department, and only after making a successful record here were they definitely added to the payroll and given regular employment.

Naturally, the main body of employees in this plant was of a high order of intelligence and capability and this fact no doubt plays an important part in the high profits of this particular corporation.

But what happens to those applicants who could not make the grade? This large factory happens to be by far the largest employer of labor in a small town, so that it would appear that all the other employers had available for employment only the so-called lower type of persons who could not pass the rigorous test of the large company. Would it not be better for the general welfare of the community to have a fair cross-section of poor and good workers represented in each factory, rather than to have the more desirable body of labor concentrated in one working spot, with all the lower grades thrown together in the smaller and less scientifically organized plants?

We have labor unions today which demand, and have succeeded in forcing, the abandonment of wage incentive plans in certain industries, and it is probably not too far fetched to imagine that the time may come when these organizations may force out the employment tests as being highly discriminatory and reacting unfavorably against a considerable group of employable persons.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● Try the Ryerson "Vacation Without a Worry" plan that eliminates all thought of delayed, slow or uncertain steel deliveries—and make yours a real vacation . . . We have thousands of tons of steel in stock and for almost a century we have been demonstrating our ability to quickly and accurately deliver steel as needed . . . Let us shoulder your steel worries . . . Simply tell your assistant to "Call Ryerson when steel is needed." Emergency as well as regular requirements will be taken care of promptly. Joseph T. Ryerson & Son, Inc. Plants at Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Buffalo, Boston, Philadelphia, Jersey City.
RYERSON

"Here's Where I Get My Speed—Dual Continuous Control of the "SAE" gives me the right *type* of arc and the *exact welding current* for smoothest possible performance on every job. I spatter less and weld better.

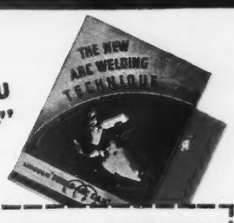
"Here's Where I Get My Endurance—The "SAE" welder is self-protected against burnout so you can use me in my bigger sizes and get top speed *continuously*.

"That's how I'm *sprinting the marathon* these days—giving '*Shield-Arc SAE*' users 15% to 20% faster welding than they can get with 1937 model welders of conventional design.

"Yours for lower welding costs,
"FLEETWELD ROD"

—Spokesman for all progress-minded welding electrodes and emissary of

THE LINCOLN ELECTRIC COMPANY
Largest Manufacturers of Arc Welding Equipment in the World



LINCOLN "SHIELD-ARC SAE"

THE WELDER WITH DUAL *CONTINUOUS* CONTROL

THE LINCOLN ELECTRIC COMPANY
Dept. R-399, Cleveland, Ohio

☐ My welding application is_____
How can the "SAE" do it faster?

☐ Send a free copy of Bul. 412 giving details about the new *"Shield-Arc SAE"* welder.

Name _____ Position _____

Company _____

Address _____

City _____ State _____

It would seem that this problem must be approached from a more realistic viewpoint, in the light of the present feeling that employers must give more and more consideration to an increasingly human and humane handling of the whole labor problem. Each employer must realize that not all persons are cast in the same mold, and be willing to accept employees from the entire range of applicants, and not force the less desirable types of persons on the smaller industries, or on the relief rolls.

HERMAN DRACH, *Superintendent*
Animal Trap Company of America
Lititz, Pa.

Henning Is Right

Professor Henning is correct in his statement ("Only One Way to Figure Delay Per Cent," *Factory*, June) on the formula for calculating the percentage of delay time. Too often in the past the time-study man has spent hours in determining the percentage of avoidable and unavoidable delay, and then tossed these results to the wind with improper calculations.

Here at the Eagle Pencil Company, until a short time ago, it was customary to figure our downtime on the following basis: Allowed downtime for a machine was 6.68 minutes per hour over a 9-hour day. Therefore, downtime was:

$$\frac{60.12}{540} = 11.1\%$$

Sometime ago, while we were explaining the delay time of a machine whose standard we had just calculated to one of the divisional superintendents, we discovered that the production called for was greater than the allowed minutes of the day could produce. Having discovered this error in calculation, we immediately changed to the following formula:

$$\frac{60.12}{540 - 60.12} = 12.5\%$$

This mistake in calculating delay percentage is a very important one, and too much effort cannot be put forth to clear this matter up in the minds of experienced men and beginners in the time-study field.

I sincerely believe that Prof. Henning's article is one of great value, and should be read by all interested in time and motion study.

J. J. BAER
Methods Department
Eagle Pencil Company, New York

•

Working Conditions

Speaking before the Chamber of Commerce of the United States on "Working Conditions in Manufacturing Plants," B. C. Heacock of Caterpillar Tractor Company, Peoria, Ill. listed "some of the points suggested by this topic." Here is his list:

1. Wages, with the collateral questions of wage levels.
2. Wage computation methods.
3. Wage payment intervals.
4. Differentials for varying degrees of skill and responsibility and different lengths of service.
5. Sex differentials.
6. Regional differentials.
7. Increased wage rates for overtime.
8. Profit sharing and bonus and pension plans.
9. Hours of employment per day, week, month, and year.
10. Time of day of various shifts
11. Rest periods.
12. Safety provisions.
13. Shop equipment as it relates to relieving operators from fatigue, both physical and nervous.
14. Elimination of nerve-distressing noises and odors.
15. Health conditions and medical and surgical facilities.
16. Drinking, bathing, and toilet facilities.
17. Lockers.
18. Heating, lighting, and ventilation.
19. Group life, health, and accident insurance.
20. Character, capacity, and attitude of direct supervision.

Solve tomorrow's CONVEYOR PROBLEMS today . . .
BELT CONVEYOR
SLAT CONVEYOR
TROLLEY CONVEYOR
CHAIN CONVEYOR
OVEN CONVEYOR
GRAVITY CONVEYOR
WEBB
Webb Material Handling Equipment has been constantly improved throughout the years—yet no user has found himself faced with costly obsolescence, for each new development has been so engineered that it can be readily adapted to existing equipment.
In innumerable instances, manufacturers have purchased one small Webb unit and added to it time and again as production increased. That is why, the world over, Webb Conveyors have an enviable reputation for being a profitable investment, not an expenditure.
JERVIS B. WEBB COMPANY
Conveyor Engineers and Manufacturers
8951 Alpine Avenue • • • Detroit, Michigan

The Water Went Down and . . .

PROSPECT MILLS, INC.
South Canal Street
LAWRENCE, MASS.

February 23, 1937

Mr. H. C. Leonard,
Globe Rubber Works
45 High Street
Boston, Mass.

Dear Mr. Leonard:

Writer thought it might be of interest to you to know that the two water wheel drive belts which we ordered from you November 19, 1935 on our order #227 and were put on the wheels in the early part of Dec. have stood two floods and are running as perfect as the day of installation. These belts were 12" 8 ply compensated belts.

In the first flood early in March 1936, these belts were under water for five days, the height of water over the belts at this time was 1 to 7 feet in depth. As the water receded we removed and dried the belts out, about two weeks later we reached our second flood which left them under water from 1 to 20 feet for 12 days. After the flood receded we went thru the same operation, drying these belts out and then dressed them. We find today, that these belts are just as good as the day they were put on new, and we have not even had to take them up.

Under seperate cover I am sending you some pictures which were taken of the water wheel and casing, showing the belts as they are now running. The wheel pit being small, I was unable to show you the entire lengths of the drive and only one side of the double horizontal wheel.

It maybe of interest of you to know that all of our other belts in the flood were ruined, most of them beyond repair. Writer believes that these two drive belts surely speak for themselves in regard to quality and service.

Yours very truly

PROSPECT MILLS, INC.

By Chas. F. Estey Mgr.

Condor Compensated PATENTED TRADE MARK REGISTERED Went Back to Work

Last year's floods are still news at the Prospect Mills, Lawrence, Mass. . . . especially when belts are mentioned.

Two water wheel drives at this dyeing and processing plant were equipped with Condor Compensated Belts. Today, "these belts are just as good as the day they were put on new." And they should be—under ordinary conditions.

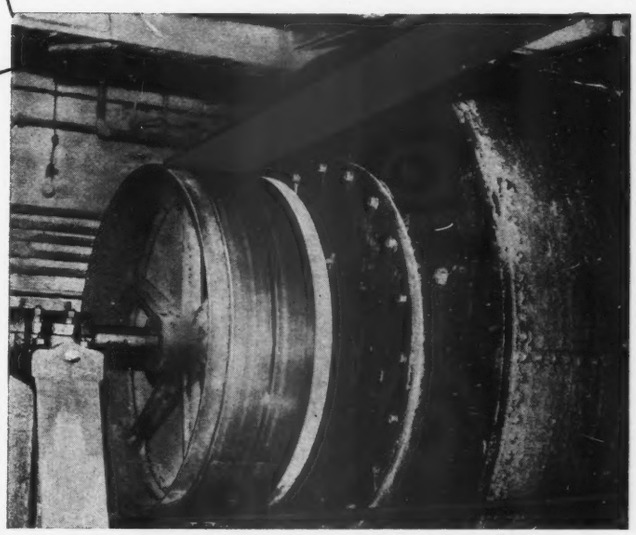
But March, 1936, was not *ordinary* for New England. Twice rivers went on a destructive rampage. Twice Prospect Mills were flooded. Each time Condor Compensated was down—but not drowned. A total of seventeen days, submerged—down to twenty feet once, but each time Condor Compensated came up, was cleaned, dried, dressed and returned to duty.

Fortunately, floods do not happen every day—there's no need to add "flood-proof" to the 12 advantages* inherent in Condor Compensated's equalized ply construction. But for lasting, steady power drives (another way of saying top economy) specify Condor Compensated, the low tension rubber belt.

*12 ADVANTAGES

1. Ruptures in outside ply practically eliminated.
2. Ply separation practically eliminated.
3. Longer fastener life.
4. Operation less affected by atmospheric conditions.
5. Less bearing, shafting and hanger troubles.
6. High efficiency.
7. Higher overload capacity or margin of safety.
8. Less wear on pulley side.
9. Can be operated on smaller pulleys.
10. For heavy loads, plies may be increased with same pulleys.
11. Can be dressed without destructive effect.
12. Material reduction in belting costs.

Condor Compensated Belt is also available in type F and B for drives where some slip is desirable.



One of the two 12", 8-ply Condor Compensated Belts still operating on a double horizontal water wheel drive at Prospect Mills, after two floods had ruined "all other belts, most of them beyond repair." This installation was sold by Globe Rubber Works, Boston, Mass. . . . a Manhattan distributor.

SOLD BY LEADING JOBBERS

THE MANHATTAN RUBBER MFG. DIVISION
OF RAYBESTOS-MANHATTAN, INC.

EXECUTIVE OFFICES AND FACTORIES, 33 TOWNSEND ST., PASSAIC, N. J.

21. Type of fellow workers.
22. General shop rules.
23. Recreational and entertainment activities.
24. Educational and advancement opportunities.
25. Nepotism.
26. Saving and investment facilities.
27. Restaurants.
28. Company stores.
29. Automobile parking facilities.
30. Housing.
31. Holidays.
32. Rules regarding absence and tardiness.
33. Accountability for property.
34. Liquor.
35. Attitude toward labor unions.
36. Organized industrial relations activities.
37. Consistency of policies.

•

Tea Fights Fatigue

Serving tea to employees, a growing trend in American offices, is converting the late afternoon slump at the day's "zero hour" into a "bright idea hour," Dr. Donald A. Laird, Director of Colgate University's Psychological Laboratory, told the members of the National Office Management Association at their annual conference in Chicago. Tea in relieving light fatigue also serves to quicken mental processes and mental associations.

Citing light breakfasts and lunches as responsible for increased susceptibility to fatigue among office workers, Dr. Laird said that food and drink during working hours constituted a relatively new approach to the problem of human fatigue. "About two hours after eating, the office worker has a stomach resembling an agile pretzel—sooner after a skimpy breakfast or a light lunch. This causes restlessness, irritability, distractibility. The only cure is to put something into the stomach, something which will allay the hunger contractions of the stomach, not satiate appetite, and at the same time not go into fat."

These 7 INTERCHANGEABLE MOUNTINGS *save you money*

P&H HOISTS

Any size P&H Hoist is available with these standard types of mountings:

1. Bolt or lug suspension
2. Hand-geared trolley
3. Plain trolley
4. Hook suspension
5. High lift
6. Motor-Driven trolley
7. Base Mounted

Through modern, simplified design, P&H Hoists are available with interchangeable mountings to meet all sorts of material handling applications. This feature makes it possible to change from one type of service to another at a minimum of time and expense. Check into the other money-saving features P&H Hoists offer you.

Send for New Catalog

A post card is the easy way to get your copy of the complete, new P&H Hoist Catalog. Write for Bulletin H-5. Address the Harnischfeger Corporation.

4525 W. National Avenue Milwaukee, Wis.

Handle it *"Off the Floor"* with

HARNISCHFEGER CORPORATION

HOISTS · ELECTRIC CRANES · MOTORS · ARC WELDERS · EXCAVATORS

Letters from the Editor

•

The following letters were written by the Editor in reply to specific inquiries. They are published here in the belief they will be of interest and help to many of our readers.

Dear ————:

I think you are wise to look forward toward the possibility of labor trouble, even though none is on the immediate horizon. In looking forward, you are of course aiming to exercise some preventive anticipation.

Yes, I think I can tell you something about company unions. Probably the most important thing I can say is that at this writing they have no standing at all with the National Labor Board. Also, they are not likely to have standing with state labor boards. New York State, for example, has just passed a labor law which outlaws company unions or employee representation plans in connection with which the employer took some part in initiating or supporting—no matter how long ago.

Obviously then, the answer to your question as to what you can do in the way of initiating such a union is that you can't do anything at all and still be within the law. In saying this I am talking to you as a part of management. If I were talking to those of your employees who have no management responsibilities whatever, I should say: It is okay for you men to set up a company union or employee representation plan, and through it to deal with management in regard to wages,

one man on a COOL job is worth ten on a hot one . . .

VANO *Air at high velocity* **AEROPLANE** *Moves large volumes*

COPPUS PORTABLE HEAT KILLERS

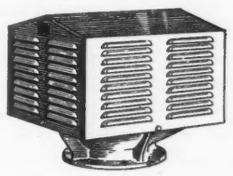
. . . Because man's ability to work goes down as the thermometer goes up — until at 110°, he's about 1/10 of normal.

This Summer — keep *your* men cool with Coppus Heat Killers; the only type of man cooling fan that actually directs a breeze of air onto the job! It's one way of avoiding losses through production slow-ups.

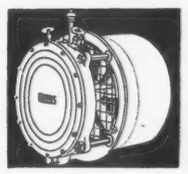
Write us for Bulletin 160-4.

In manholes or in *any* confined working space: tunnels, pipe galleries, coal pockets, process tanks, storage bins, etc., the Cable Manhole Ventilators. (Bulletin 163)

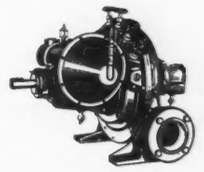
For rapid cooling and ventilation of boilers, tanks, retorts, etc., the Boiler Manhole Blower. (Bulletin 161-3)



To increase boiler capacity or to improve draft conditions, the Forced Draft Blower. (Bulletin 145-4)



Attached to the intake of air compressors and engines, the Coppus Air Filter provides clean air, free from abrasive dust particles. (Bulletin F-310-3)



The lowest-priced high-quality steam turbine you can buy. 6 sizes from 1 to 150 H.P. (Bulletin 135-8)

For bulletins, address COPPUS ENGINEERING CORP., 375 Park Ave., Worcester, Mass.

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hours, and working conditions; but in no case must you ask the consent or advice of management. The things must be entirely your own, run by you, off company property, without accepting a cent of help from the company for printing or anything else.

I attach a copy of the National Labor Act. Read it carefully—particularly those parts referring to employee representation plans or company unions as units for representation. Read also the article "What the Labor Board Thinks the Labor Law Means," published in May *Factory*. And then in the June issue of *Factory*—read particularly the editorial "Free to Choose, But—." This editorial deals with the new New York State Labor Law, which is very definite as to company unions.

Now, I don't know whether this helps you or not. Some way or other your employees—if they are to have a representation plan—must get the idea that it is a good thing and that they want one. I don't believe it is safe for you to give them the idea. The chances are that they won't think of it because they will feel that you have a happy family there and that no labor troubles are going to crop up. All of this will be well enough until C.I.O. or A.F. of L. or somebody stirs things up, and then of course the employees won't know where they are any more than you will know where you are.

Dear Mr. ————:

On my return from the Spring Meeting of the A.S.M.E., I find a note relative to your 'phone call of last week and a carbon of the letter that my associate Urquhart wrote you.

Urquhart expressed fairly well my conclusions relative to employee representation plans as you and I know them, and which enthusiastic New Dealers are given to calling "company unions."

I conclude from a reading of the New York Act and from findings of the Federal Labor Board that employee representation plans do not have any place in the picture unless it can be proved that they were initiated and carried on by employees alone—entirely uninfluenced and unsupported, morally or financially, by anyone in any way representing an employer.

You will see that New York State really is retroactive in condemning an employer's participation in an employee representation plan. So are the rulings of the National Labor Board.

There is just one ray of hope, and it lies in the uninfluenced action of employees to salvage their own employee representation plan. I noticed in one of the New York papers the other day a statement to the effect that the employees of an oil company, learning now that their plan is not in good standing because their employers had something to do with its origin, are intending by their own action to divorce it from employer participation and revise it so that it can be carried on as strictly employee property.

I think that if I were an employer and having no labor trouble, and if my employees were dealing with me through an employee representation plan, I should say to them frankly, "Here is the situation: Your employer helped to initiate this plan. He has furnished the meeting place. He has done this and that—all of which put together probably outlaw the plan in the eyes of labor boards. Therefore, if you wish to continue to deal with me under this plan, it is up to you to revise it to make certain that it is strictly your property and something with which I have nothing to do."

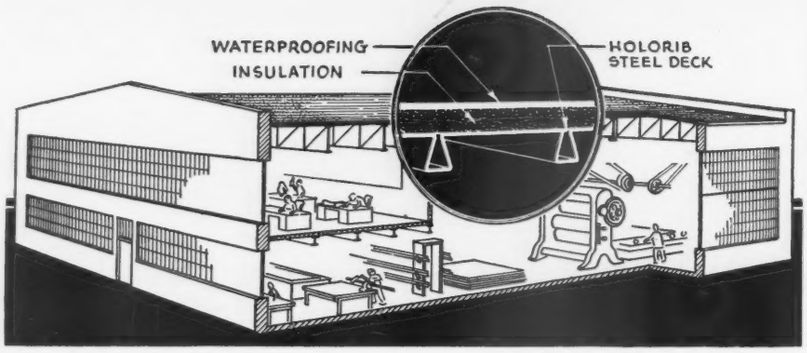
* * *

Dear Mr. ————:

It was, as you know, the decision of the Labor Board in the Stockyards case that the Act itself imposed upon the employer the obligation of signing an agreement. The Supreme Court stated specifically that nothing in the Act does require an agreement. I seem to remember that the Labor Board itself also made that statement.

I am inclined to believe that both the Supreme Court and the Labor Board had in mind that nothing in the law compels the bargaining parties to reach an agreement. It requires only that they bargain in good faith in an attempt to reach an agreement. Failing to reach an agreement presumably calls for no penalties under the law. In

A ROOF THAT
Controls Your Weather



A Fenestra Holorib Steel Deck, properly insulated and water-proofed, will have more to say about the weather inside your plant than any other features of your building.

It will keep the inside temperature cooler in summer.

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It will enable you to maintain any predetermined percentage of relative humidity desired for comfort or special manufacturing processes without the danger of condensation, drippage, discoloration or spoilage.

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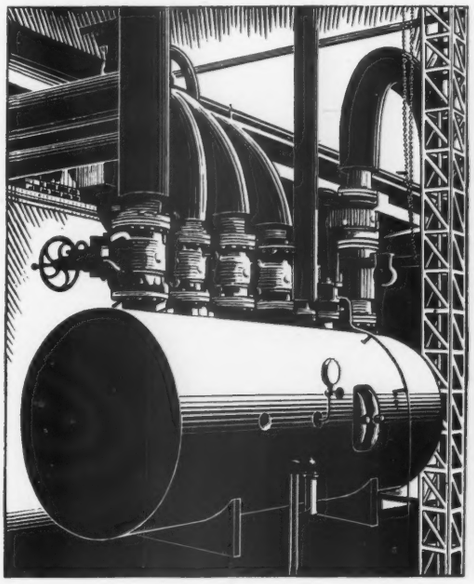

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THE VALUE and efficiency of insulation materials deteriorates with time when left exposed to the damaging effects of infiltration of air, moisture, water or corroding fumes. The effects of vibration and abrasion also take their costly toll on unprotected insulation materials.

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practice, both the employer and the employee are likely to suffer penalties because employees are likely to strike or to continue an existing strike with the hope that they can force the employer to submit to their terms.

On the other hand, the Labor Board held in the Stockyards case—and it is my opinion that it still holds—that once an agreement has been reached (that is, once there has been a meeting of minds) the agreement should be written out and signed. I think it is the Board's contention that signed statements setting forth the terms of agreements are the usual normal procedure in contractual relations. It does not see why there should be any more hesitancy in regard to the terms upon which labor is employed than there should be in acknowledging in writing the terms of a lease or a purchase of materials or equipment.

In my opinion the Board sees a difference between a requirement of the law that there must be a meeting of minds (which requirement does not exist) and the implied requirement that once an agreement has been reached the terms shall be put on paper and acknowledged by the contracting parties.

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THE ELECTRIC CONTROLLER & MFG. CO., CLEVELAND, OHIO

Cash Out Is Cash In

(*Continued from page* 55)

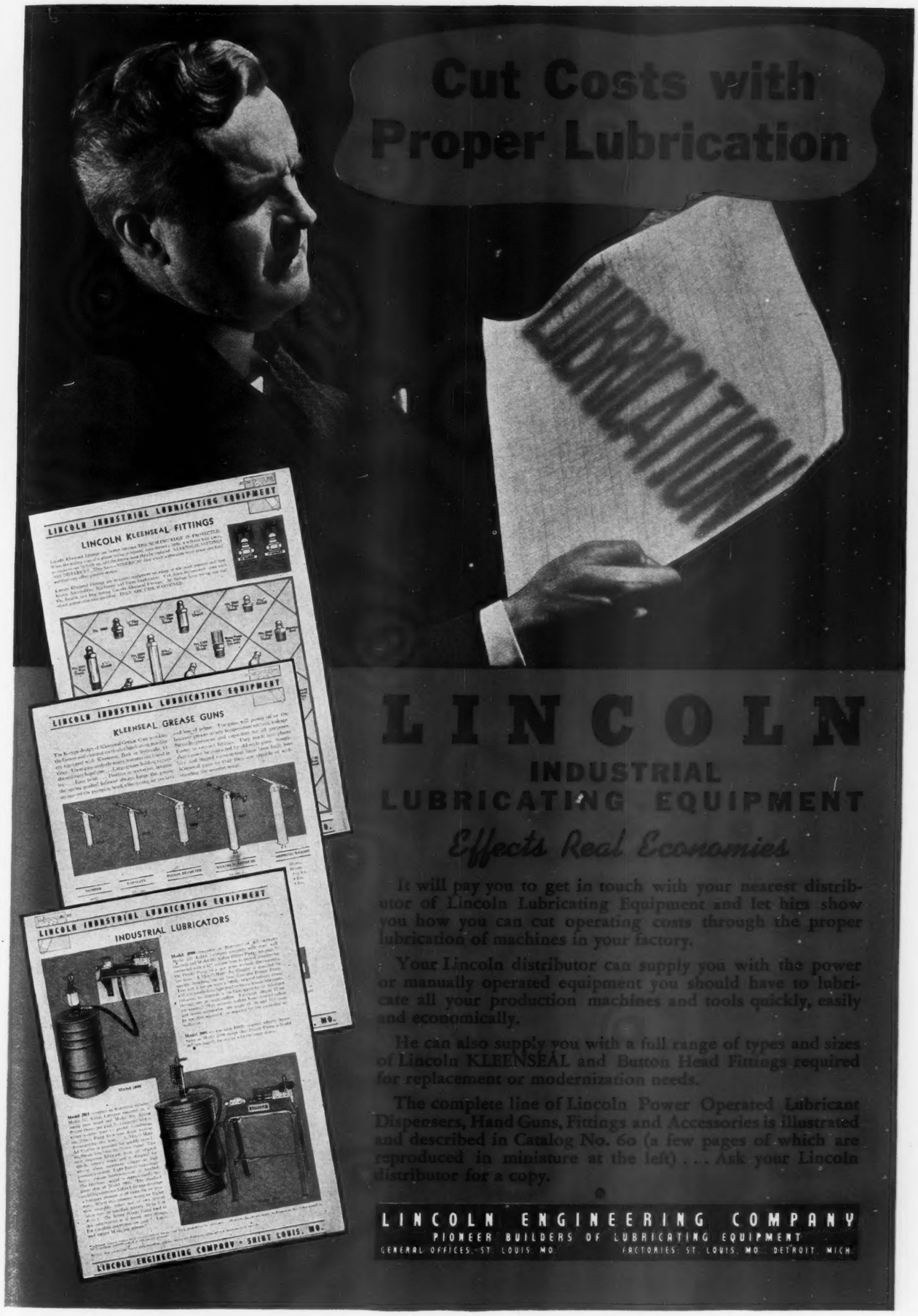
applied especially to remedy them. The department is still short of perfectly even temperature on some days, but temperature is much more even than it has ever been held in any other fashion. The experience in respect to work volume and quality, and ill-health absences, has in this department repeated the expectation by previous installations.

Not far distant is a new row of laboratories, where experimental work is handled along mechanical, chemical, and physical lines. These were built in 1936, and were air conditioned as a matter of course. The rooms are smaller, ceilings lower. Insulation was provided with foreknowledge of the conditioning. Consequently the laboratories hold even temperature and humidity, with benefit to the materials worked with as well as to the experimental men and their technicians.

Where Precision Is Required

The room in the plant where cylinders are diamond-bored is large. It was not originally constructed for air conditioning. But the work requiries an evenly regulated temperature for precision, and unless the air were also cleaned there would inevitably develop many unpleasant odors in so large a department. Consequently it is completely conditioned. The purpose here is entirely to maintain proper conditions for precision metal-working, and the value attained through these good conditions makes this unquestionably profitable.

Similar conditions are maintained at other than the Rouge Plant where advisable. For example, at Northville, Mich., is the little plant where gages are made; its refrigerating unit cooled the Ford exhibition building at the Texas Centennial last summer. Close by is the Newburgh Plant, making small twist drills for Ford use. The plant has only 18 employees when working to capacity. Nevertheless it is air conditioned, and has a standby compressor as well as the one regularly in use. This is the newest Ford plant, and it is significant that it is conditioned. Experience here, as everywhere else, confirms the effect of conditioned air in reducing absences and maintaining level production.



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The complete line of Lincoln Power Operated Lubricant Dispensers, Hand Guns, Fittings and Accessories is illustrated and described in Catalog No. 60 (a few pages of which are reproduced in miniature at the left) . . . Ask your Lincoln distributor for a copy.

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Plant factory buildings are small inspection departments and similar units concerned with precise measurement. In most of these, a small number of men—often only two—are working. Consequently, with adequate headroom and sizable cubic capacity per man, humidity control and forced ventilation are dispensed with. The work is of a sort that does not generate odors, and leakage of outside air into the rooms is sufficient for a normal air supply. However, these rooms are cooled or heated to maintain an even level of temperature as required by the work.

It seems probable that Ford Motor Company is the largest single user of air-conditioning equipment in industry. Its experience has convinced those in charge that, even aside from those departments where conditioned air is essential for proper handling of materials, it pays in increased production, steadier production, better work, and better health. Such results make air treatment profitable in a great many kinds of plant area where it has seldom been tried by other concerns.

When Wiring Your Plant

(*Continued from page* 96)

(2) Manner in which the cable is installed, as in ducts, buried in the ground, in conduit, open or in other ways. (3) Ambient temperature of the surrounding medium in which the cable will operate.

When all the factors are known, conductor size can be calculated from well-known formulas. Any copper conductor will carry the maximum current when bare and installed in the open air. Any conductor surrounded by insulation will have its current-carrying capacity somewhat decreased due to the necessity of dissipating the heat loss through that insulation. If a cable is installed in conduit, there is a still further limitation, although it may be small. When the surrounding air is warm the ability of the cable to carry current is reduced accordingly. The more cables there are installed close to each other, as in the same conduit or duct line, the greater the reduction in their individual ampere capacity.

Since there are so many variable items to consider in calculating the allowable amperes in any cable, it

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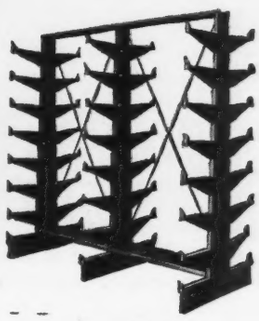
Shop Boxes



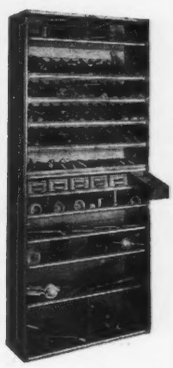
Bar Racks

Part of a Lyon Equipped Tool Room

Shoprobe

Stock Handling Cart

Shop Equipment



Tool Room Equipment

● In these days of mounting costs increasing sales often fail to yield anticipated profits. To *offset* unavoidable drains on profits, new economies in manufacturing must be sought. One place where substantial savings can generally be effected is in materials handling . . . in labor, unbalanced stock inventory, material losses . . . and the release of valuable floor space for actual production work.

Lyon equipment has definitely demonstrated its ability to save floor space, time, labor, and to reduce inventory losses in many leading industries. A Lyon Storage Equipment Engineer will be glad to cooperate with your plant executives in seeking practical economies in your parts and material handling methods. Just check and mail the coupon for details . . . or preliminary catalog information.

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Send me complete information as checked:

- ☐ Storage Shelving
- ☐ Stock Handling Cart
- ☐ Shop Equipment
- ☐ Bar Racks
- ☐ Lockers
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- ☐ Shoprobe
- ☐ Tool Room Equipment
- ☐ Storage Cabinets
- ☐ Folding Chairs
- ☐ Have representative call:

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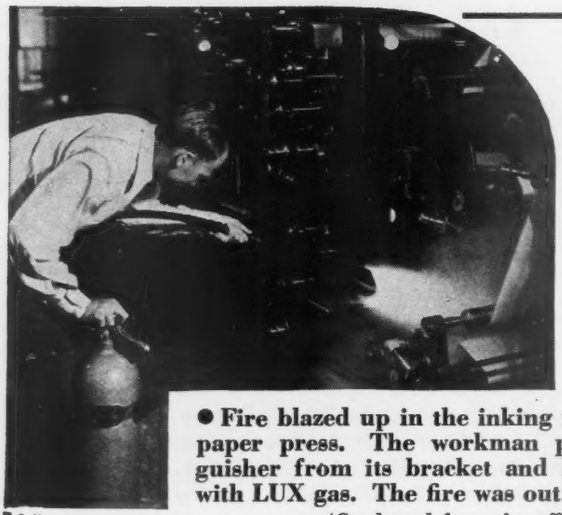

He couldn't figure out where the **Fire** *went to*

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LUX's extinguishing principle is simple. LUX carbon-dioxide gas expands 450 times, penetrating the entire fire area, even into hidden or remote crevices. Fire cannot live in this atmosphere.

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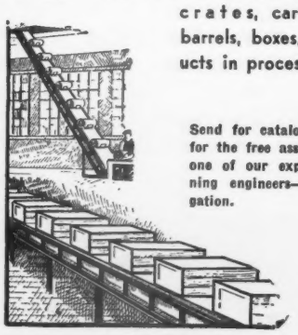

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is necessary either to make the calculations with all these items in mind, or to select a conductor size which previous experience or reliable information shows will be ample. If it is necessary to estimate the conductor size, it is much safer to be sure that the conductor is large enough, rather than to take a chance on its being too small. Too small a size will overheat and destroy the insulation, interfere with production, and waste money.

Check Feeder Size

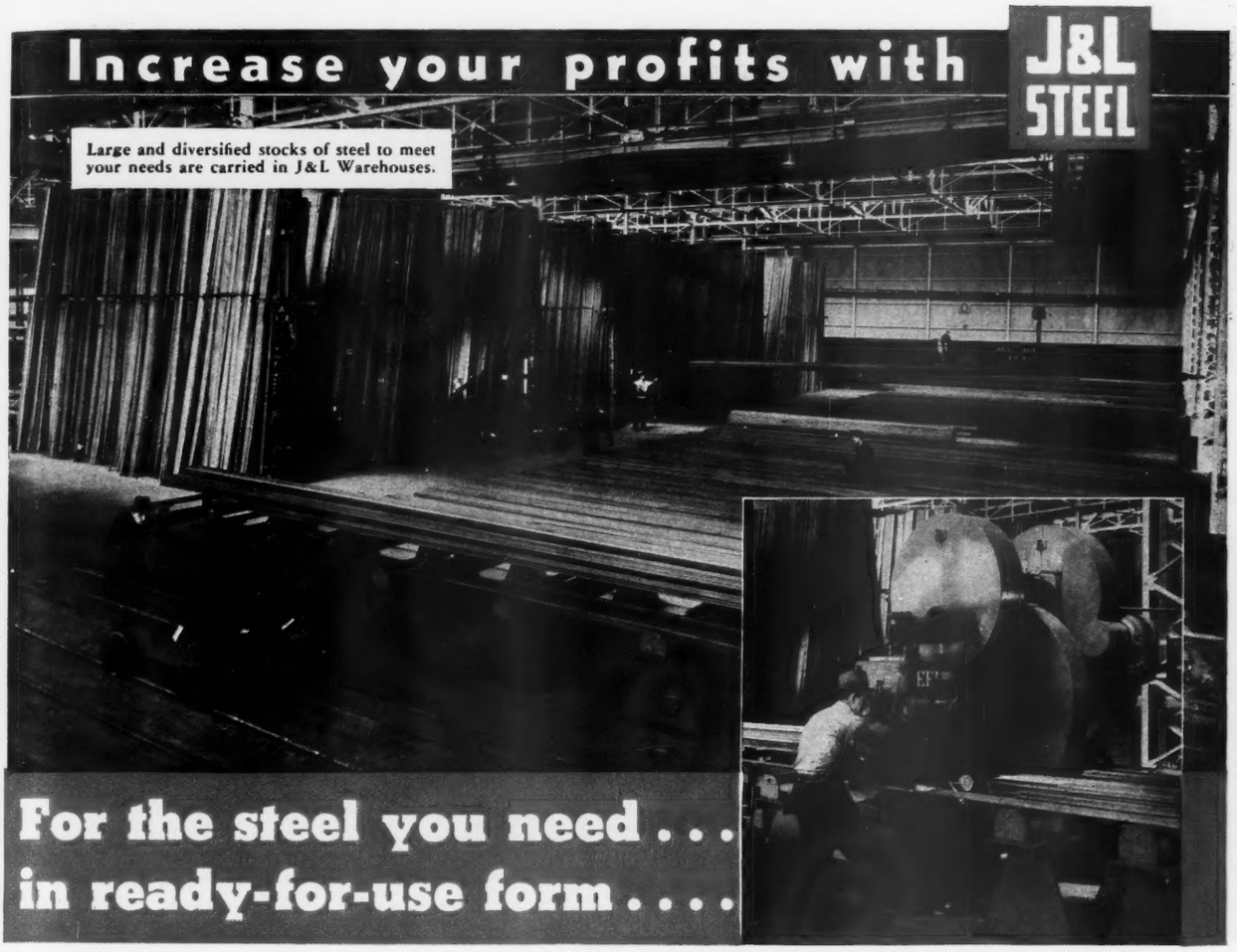
After the size of the feeder has been selected, check the voltage drop obtained when starting the largest motor connected to it, to make sure that the minimum proper voltage will be maintained during starting. This minimum value can be obtained from the motor manufacturer.

It is usually preferable to limit conductors to a few standard sizes determined by the requirements of the plant, rather than to use all sizes. When a conductor size determined for a job lies between two standard sizes, select the next larger standard.

The question arises as to the maximum size of conductor that should be used in feeders and branch circuits. If the conductor size is made too large, the cost per foot and the cost of conduit will be found to increase rapidly. Size No. 4/0 A.W.G. on a 550-volt system has been found to be a convenient size beyond which two or more conductors in parallel can be used except possibly in the case of quite large plants. Use of this or another maximum size will help to limit the number of cable sizes in the storeroom, and add greatly to the flexibility of the feeder system.

Six Better Than Three

Even with conductors smaller than No. 4/0, it may be found cheaper and easier to draw in six wires of one size, rather than three of equivalent area, because of the reduction in conduit size, ease of handling, and convenience in making future changes in circuits. Using six wires instead of three gives the advantage of improved regulation. For example, three 1,000,000-circ.mil cables spaced closely together in a triangle and carrying 600 amp. a distance of 500 ft. will have a drop of 15.2 volts, whereas six 500,000-circ.mil cables in close hexagonal configuration, carrying the same load the same distance, will have a drop of 9.2 volts. This difference in voltage drop is due to the difference in reactance. The resistance is the same in both cases.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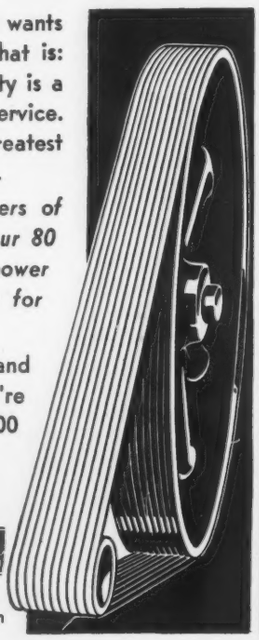

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Same management, same standards as the National Power Shows held biennially in New York
Management, International Exposition Co. 7590

Here's to Better Lubrication

(*Continued from page* 94)

Since the measurement sought is temperature rise above the surroundings, no fixed "cold junction" is necessary or desirable.

In one test of this type the whole bearing was heavily insulated, to accentuate and steady the potentiometer readings. Although the immediate objective was attained, the whole purpose of the experiment was frustrated. Bearing temperatures, which have a profound influence on oil characteristics, could no longer be regarded as typical of normal conditions.

If increased sensitivity of measurement is desired, it may be secured by the use of a thermopile. For most cases the use of a ten-couple, iron-constantan pile is recommended.

Temperature Will Tell

Record the temperature rise with the first oil chosen for test. If the bearing was cold at the start, time must be allowed for the parts to reach temperature equilibrium.

The same procedure is thereafter repeated with a series of oils, cleaning the bearing carefully before each change. In each test a different temperature rise is likely to be observed. Enough different oils should be tried so that when viscosity is plotted against millivolt readings, or their equivalent, a distinct dip will appear in the curve. This low point will indicate the viscosity which is consistant with minimum power losses.

The accompanying curve, which is based on general experience rather than the results of a specific test, illustrates how the data secured in such a test can be interpreted. In practice it is not necessary to obtain the complete curve shown; in fact, it can be obtained only by unnecessary destruction of the test bearings. The "Intolerable region" will not often be invaded, since results therein are not possible of duplication and at best the significance is purely negative.

Actually, all that is important is a determination of the "Region of lowest power loss, but doubtful safety factor." If operation is very steady the proper oil will be within this region, at a point after the curve definitely begins its rise to the right. When operation is not steady, only experience can show

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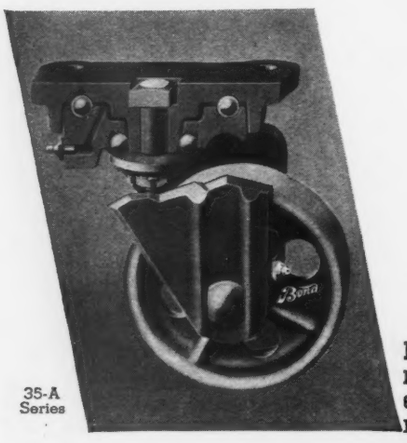

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how much further up the curve to the right one must go before occasional damaging of bearings is prevented.

If it can be done without contaminating an oil supply, this point can often be held down by occasionally running for a short time with a good graphited oil, say for 2 hours out of every 200 hours or more.

The oil thus indicated may or may not be the most desirable from viscosity considerations. It is, however, an intelligent choice for the service tests already described. The temperature-rise test is not always free from false appearances, or it may happen that minimum power losses and maximum bearing life are incompatible. Not infrequently the problem becomes one of economic balance between maintenance costs and power consumption.

For High Speed Only

Methods of securing the necessary data to strike this balance must vary so greatly under different conditions that any general treatment is likely to be unsatisfactory. Lacking such a balance a conservative and practical rule is: Use an oil which is compatible with good bearing life. In small plants the savings possible through an exact economic balance may not justify its cost.

The test procedures described will very frequently be worth many times the effort. Although they take into account little more than viscosity as it influences avoidable friction, obvious analogous methods can be used to check the relative "oiliness" of different oil types, or assist in choosing the most satisfactory type of lubricant, regardless of what makes the lubricant best for any particular purpose.

On the other hand, these tests are not a panacea and primarily are of value only with high-speed machinery. Although the basic elements could also be used for low-speed investigations, frictional losses at low speeds may be a negligible part of the total power consumption and are likely not to be worth much effort in reducing them.

The problem may be almost exclusively a matter of wear prevention when any effective means is classifiable as good practice. If speeds do not exceed 200 r.p.m., and bearing wear is no problem, there can usually be found more profitable outlets for effort than attempting to reduce friction to a positive minimum. Actually, since many slow-speed shafts are heavily loaded they cannot be provided with a well-refined oil of *adequate* viscosity, and

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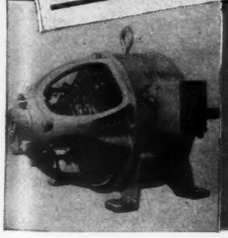

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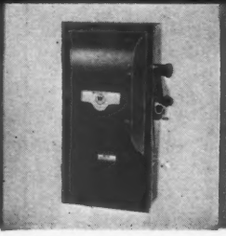

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therefore afford little or no chance to provide economies other than in wear prevention.

(*A succeeding article will appear in an early issue.*—ED.)

●

TRADE LITERATURE

Air Conditioning Units—Five bulletins: CLS-415-A, on Type CLS-415 condensing unit; CLS-640-A, on Type CLS-640 condensing unit; AH-000-C1, on Type AH air conditioning units; AV-000-C1, on Type AV air conditioning units; EV-000-C1, on Type EV evaporative condensers.—Westinghouse Electric & Mfg. Co., 200 East Fifth St., Mansfield, Ohio.

Air Coolers—Bulletin GEA-2503, on surface air coolers for turbine-generators.—General Electric Co., Schenectady, N. Y. Stop 1528

Air Filter—Bulletin No. 500-2, on round-type air filters for cleaning gases and removing solids from air.—The Northern Blower Co., 6400 Barberton Ave., Cleveland.

Amoskeag Industries, Inc.—Booklet, telling of manufacturing space available on the property of Amoskeag Industries, Inc., Manchester, N. H.

Belt—Catalog No. A-117, on Tentacular belt.—Alexander Brothers, Inc., 406 North Third St., Philadelphia.

Cable Accessories—Publication No. 371, on insulated cable accessories.—Anaconda Wire & Cable Co., 25 Broadway, New York.

Camden, N. J.—Booklet, title "Industrial Camden," showing what the city has to offer industry. — Department of Public Affairs, City Hall, Camden, N. J.

Chains—Bulletin 59, on non-corrosive and heat-resistant chains.—Baldwin-Duckworth Chain Corp., Springfield, Mass.

Circuit Breaker—Bulletin GEA-2603, on Type FK-45 indoor oil-blast circuit breaker. —General Electric Co., Schenectady, N. Y.

Condenser—Folder, on Hydro-Cyclonic condenser for refrigeration and air conditioning. —General Refrigeration Corp., Beloit, Wis.

Controller — Catalog, describing the Wide Range Controller. — Consolidated Ashcroft Hancock Co., Bridgeport, Conn.

Coolers—Bulletin GEA-2503, on surface air coolers for turbine-generators.—General Electric Co., Schenectady, N. Y.

Dust Collector—Form No. 276, on Type W Roto-Clone water spray precipitator.—American Air Filter Co., Inc., Louisville, Ky.

Electrical Equipment—Catalog No. R.I.-936, on motor and maintenance equipment and electrical specialties.—Ideal Commutator Dresser Co., Sycamore, Ill.

Equipment for Tenters—Bulletin GEA-2608, on drive and control equipment for tenters. —General Electric Co., Schenectady, N. Y.

Feeders—Bulletin 1833, describing Utah electromagnetic feeders.—Allis-Chalmers Co., Milwaukee.

Finishes—Booklet, on maintenance finishes, varnishes, and enamels.—Everseal Mfg. Co., Inc., Fisk Bldg., Broadway and 57th St., New York.

Finishing Materials—Booklet, on storing, mixing, and reducing of decorative protective coatings.—Hilo Varnish Corp., 42-60 Stewart Ave., Brooklyn, N. Y.

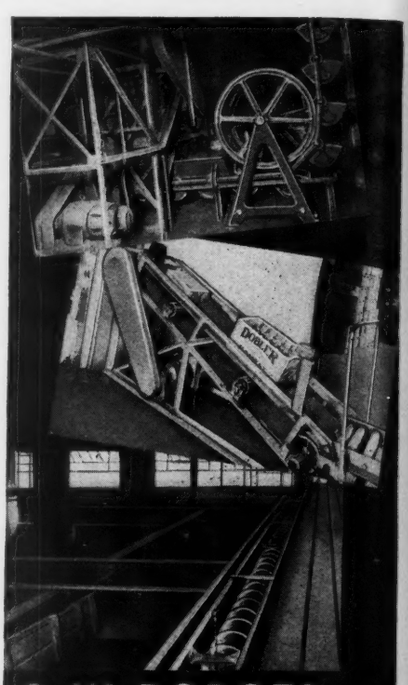
Fire Extinguisher—Folder, on anti-freeze fire extinguishers which discharge water as extinguishing material.—Walter Kidde & Co., Bloomfield, N. J.

Fire Extinguishers—Booklet, title "108 Extra Values," on line of fire extinguishers. —Walter Kidde & Co., 62 West St., Bloomfield, N. J.

Flexible Couplings—Bulletin 4100, on Steelflex couplings.—The Falk Corp., Milwaukee.

Flexible Metal Hose—Catalog on Rex-Weld and Rex-Tube flexible metal hose.—Chicago Metal Hose Corp., Maywood, Ill.

Flooring Material—Folder, on Concretite flooring material.—Stonhard Co., 401 North Broad St., Philadelphia.



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Flow Meters—Catalog, on electrical and mechanical flow meters.—The Bristol Co., Waterbury, Conn.

Foundry Screens—Bulletin No. 1480, covering foundry screens, shakeouts, and other equipment.—Allis-Chalmers Mfg. Co., Milwaukee.

Freight Carloading Stowage—Booklet, showing different types of stowage material and equipment.—The Gerrard Co., Inc., 2915 West 47th St., Chicago.

Gages—Catalog, on line of gages of all sorts.—Sheffield Gage Corp., Dayton, Ohio.

Gas Measurements—Bulletin, on methods of determining velocity, volume, dust and mist content of gases.—Western Precipitation Corp., Los Angeles

Instruments—Bulletin No. 537, telling of savings resulting from studying power problems with graphic instruments.—The Esterline-Angus Co., Indianapolis.

Insulating Brick—Folder, showing applications of JM-20 insulating brick.—Johns-Manville, 22 East 40th St., New York.

Insulation—Folder, on cork insulation for pipe lines.—Armstrong Cork Products Co., Lancaster, Pa.

Insulation—Folder, on Stic-Tite plastic insulation.—Refractory & Insulation Corp., 381 Fourth Ave., New York.

Latex Products—Booklet, showing line of products made from latex.— Collord, Inc., Detroit.

Lighting Fixtures—Bulletin No. 1004, on explosion-proof and dust-tight Unilets.—Appleton Electric Co., 1701-1729 Wellington Ave., Chicago.

Lighting Protection—Bulletin GEA-1743B, on lighting protective equipment for a.c. rotating machines.—General Electric Co., Schenectady, N. Y.

Lighting Transformer—Bulletin 142, on high-intensity mercury vapor lamp transformers.—The Acme Electric & Mfg. Co., 1440 Hamilton Ave., Cleveland.

Lighting Transformers—Catalog No. 371-ML. describing and illustrating transformers for mercury lamps.—Jefferson Electric Co., Bellwood, Ill.

Motors—Bulletin GEA-529C, on "6000 Series" low-speed synchronous motors.—General Electric Co., Schenectady, N. Y.

Noise Elimination—Brochure title "How to Quiet the Noisy Office."—Johns-Manville, 22 East 40th St., New York.

Pipe Union—Folder, describing Dualsteel union.—Rockwood Sprinkler Co., 38 Harlow St., Worcester, Mass.

Porcelain Enamel—Report, title "Test for Acid Resistance of Porcelain Enamels."—Porcelain Enamel Institute, 612 North Michigan Ave., Chicago.

Power Transmission—Crime Dossier No. 2, treating in "Crime File" manner positive power transmission for stokers.—Baldwin-Duckworth Chain Corp., Springfield, Mass.

Process Control—Folder, on Coordinated Process Control.—The Bristol Co., Waterbury, Conn.

Pumps—Bulletin W-360-B1, on Type FP centrifugal paper stock pumps.—Worthington Pump and Machinery Corp., Harrison, N. J.

Pumps—Catalog, on line of centrifugal, reciprocating, and rotary pumps. — Goulds Pumps, Inc., Seneca Falls, N. Y.

Records—Booklet, pointing out information that can be recorded on Acme Visible Record Equipment.—Acme Card System Co., 8 South Michigan Ave., Chicago.

Regulator—Bulletin GEA-2150A, on Type GDD generator-voltage regulator for d.c. machines.—General Electric Co., Schenectady, N. Y.

Roofing—Booklet, on Transite for roofing and siding.—Johns-Manville, 22 East 40th St., New York.

Sheet Metal—Booklet, title "A Guide for Sheet Metal Workers."—United States Steel Corp. Subsidiaries, 435 Fifth Ave. Pittsburgh.

Starters—Booklet, on solenoid starters.—Allen-Bradley Co., 1315 South First St., Milwaukee.

Steam Trap—Bulletin No. 337, on steam trap in four types.—W. H. Nicholson & Co., 12 Oregon St., Wilkes-Barre, Pa.

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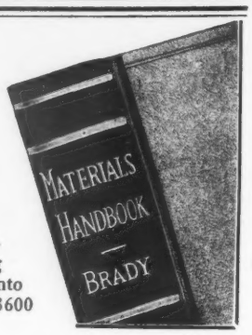

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Watthour Meters—Bulletin GEA-2404A, on two-element, single-disk watthour meters.—General Electric Co., Schenectady, N. Y.

Welding—Booklet, title "The Welding of Enduro Stainless Steel."—Republic Steel Corp., Cleveland.

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BOOKS

COLLECTIVE BARGAINING

R. D. Bundy, Industrial Coordinator, Board of Education, City of Cleveland. National Foremen's Institute, Inc., 60 East 42nd St., New York. 43 pages. $1.

This little book approaches the subject of collective bargaining in an objective manner, looking at it as a problem facing management and workers. After outlining its development and pointing out the defects which have crept in, it suggests steps to be taken in making it work.

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Charles Reitell, Ph.D., Stevenson, Jordan & Harrison, Management Engineers. The Ronald Press Co., 15 East 26th St., New York. 186 pages, index. $1.50.

Basing his treatment of foremanship on the theme that foremen are managers, the author shows the necessity for a foreman's having a mastery of the human elements, a grasp of technical requirements, and a knowledge and use of costs and budgetary controls. By pointing out the elements of these three divisions of duties, he shows how better foremanship is to be achieved.

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ON THE CALENDAR

AUGUST

25-28, Silver Bay Conference on Industrial Relations, Silver Bay, N. Y. Charles A. Herschleb, 347 Madison Ave., New York.

29-Sept. 2, Leipzig Trade Fair, Fall Session, Leipzig, Germany. Leipzig Trade Fair, Inc., 10 East 40th St., New York.

31-Sept. 3, American Institute of Electrical Engineers, Pacific Coast Convention, Spokane, Wash. H. H. Henline, Secretary, 33 West 39th St., New York.

SEPTEMBER

23-25, National Industrial Advertisers Association, Inc., 1937 Conference, Chicago. Miss Mildred R. Webster, Headquarters Secretary, 100 East Ohio St., Chicago.

OCTOBER

4-9, Chicago Exposition of Power and Mechanical Engineering, Chicago. Charles F. Roth, Vice President, International Exposition Co., 480 Lexington Ave., New York.

11-15, National Safety Council, Annual Meeting, Kansas City, Mo. W. H. Cameron, Secretary and Managing Director, 20 North Wacker Drive, Chicago.

18-22, American Society for Metals, National Metal Congress and Exposition, Atlantic City, N. J. W. H. Eisenman, Secretary, 7016 Euclid Ave., Cleveland.

24-29, National Electrical Manufacturers Association, Annual Meeting, Chicago. W. J. Donald, Managing Director, 155 East 44th St., New York.